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Practical and Theoretical Mechanics and Chemistry.

Account of the performance of the Screw-Ship Archimedes.

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Sir—Previously to my leaving London last September, I visited the screw ship Archimedes, and was very much gratified with her appearance as a ship, and with the compactness of her engines and screw propeller. The following account of her first voyage from London to Portsmouth is not without great interest to steam navigation.

Very respectfully, yours,
W. STRICKLAND.

Philadelphia, November 21st, 1839.

The first voyage the Archimedes performed was to Sheerness, from thence to Margate and Ramsgate; she accomplished every thing that was required of her, in the most perfect manner. At Sheerness, Admiral Sir Robert Otway came on board, who took the helm and steered her for some time, and in a letter to Chas. Caldwell, Esq., dated Sheerness, May 12th, he expressed himself in the following terms.

"I steered her myself for some time, and I was much surprised and pleased at the quick manner in which she answered the helm, and I must also observe, that she moved quickly over the water, and at a fair rate. I think your having got rid of the paddle boxes, and the engines being placed so low down, are very great improvements, and must lead to the introduction of the screw into Her Majesty's service.

"I enclose a most gratifying report from an intelligent officer, who happened to be on board the Archimedes at the time, and went in her to London."

Report of Lieutenant Wright.

"In compliance with your desire respecting the observations I had an opportunity of making on board the Archimedes, on the passage from Sheerness to London, last Wednesday, I beg to state, that from what I saw, I consider the principle of propelling by the screw as perfectly established, the vessel having gone at one time, an exact mile in six minutes and a half, though under the disadvantage of the propeller being too large for the power of the engine, to give it the necessary rapidity of rotation. She steered admirably well, stopped, and backed with a readiness and facility equal to the steamers with paddles, and during the short time we were under sail and the vessel heeling over considerably, she behaved fully as well, and I could not detect the least motion in the vessel, caused by the propeller, similar to that of vessels with paddles; she went very smoothly through the water, leaving only an agitated stream on each side of her rudder, and so on in her wake.

"Upon the whole, I consider the invention will turn out to be one well adapted to combine both the sailing and steaming of vessels together. The propeller from its situation, two feet below the surface of the water, is completely protected from the range of shot, and being above the keel, could not be injured by touching the ground, and I believe it will be found perfectly practicable to ship and unship the propeller with great speed, by raising or lowering it down in a groove inside the vessel. The great number of advantages the invention offers, over the paddles, must, of course, be obvious to every one.

I must now notice the points that appeared to me objectionable. The first is, the very great vibration of the engine, caused by the cogged wheels, necessary to carry the power to the main rod of the propeller, but this objection, I believe, may be removed. The next is, that I should fear that the great length of overhanging stern required to make the requisite room for the propeller, might, in a heavy sea, and the vessel pitching much, cause her to be much strained abaft; but at the same time, I should hope that even this objection might be remedied."

Eminently successful in this our first experiment, the Archimedes was prepared to go to Portsmouth, upon the occasion of the launch of Her Majesty's ship, the Queen, of 120 guns.

She performed this voyage with equal success to the first, I may add in a most brilliant manner, under stress of severe weather, and head winds, for the most part of the voyage, accomplishing the distance from Sheerness to Portsmouth, in 21 hours, including the time occupied in taking up her station alongside the Victory. She there remained till the 19th of May, when she returned to London. During the time she was at Portsmouth, she was visited by all the great naval characters who were assembled to witness the launch of the Queen, and she was open to the inspection of nautical men of every description, and elicited from them expressions of unequivocal admiration.

I here add an extract from a letter of Admiral Flemming to Mr Tuffnell, dated, Portsmouth, May 19th.

"I was on board and went out of the harbour in her, so did Lord Dundonald, and several other naval men, who all think most favourably. The day of the launch, there was no one to attend, and next day, unfortunately, a court martial, which prevented two Captains going there.

"I think it a most useful invention, and capable of being turned to good account in war vessels; she made a great impression on all who saw her, and a most favourable one. In rivers it is invaluable, as it causes no swell to hurt boats. It is not affected by the inclining of the vessel under sail; the only drawback is from the constant friction."

These combined facts, and the opinions of such authorities appear distinctly to prove the problem solved respecting the powers of the screw in navigation, and its superiority over the paddle; nevertheless, the public will require still further evidences, and it is obviously our business to furnish them.

The above is extracted from a statement drawn up by Lord Western.

On the new Metal, Latanium. By James C. Booth and Campbell Morfit.

A notice of the discovery of this element having already appeared in one of our Scientific Journals, it occurred to us that an account of some of our experiments with it might present a subject of sufficient interest to the readers of the Institute Journal.

The name is derived from the Greek λανθανειν, to lie hid;* it is called in Swedish and German, Lantan, but in English Latanium, for the sake of euphony and in accordance with the generally received termination of the names of the elements. The ordinary method of obtaining cerium by precipitation with the bisulphate of potassa, threw down a bi-salt of Latanium at the same time, the latter constituting two-fifths of the whole saline mass. The method of separating the two depends on the ready solubility of oxide of latanium in dilute acid after ignition, a property lost by cerium under the same circumstances. From its nitric solution, it may be best thrown down as a white, crystaline carbonate, by carbonate of ammonia, and from this its other compounds may be formed.—The dry chloride heated with potassium was reduced to a gray metallic powder possessing a dark lead-color, and capable of being flattened together by pressing. It is slowly converted into oxide in the air, and in cold water into a hydrated oxide with the evolution of hydrogen. An effervescence takes place in hot water.

It has two isomeric states. The ordinary salts possess a faint reddish tinge, but when the yellowish red oxide is heated in hydrogen gas, it becomes white with a faint shade of green, and dissolves with more difficulty in acids, forming salts which possess a greenish hue.

With bisulphate of potassa it forms a slowly soluble salt, which, however, does not precipitate like the corresponding salt of cerium, unless the latter be also present in solution. Its atomic weight is lower than that adopted for the oxide of cerium.

The above notice is mainly extracted from Berzelius' letter to Poggendorf, published in Nos. 4 and 5 of Poggend. Annals for the present year. Our experiments were as follows.

Having prepared the sulphate of cerium and potassa by the ordinary methods from the mineral cerite, it was dissolved in a large quantity of boiling water, and the hydrated oxides of cerium and latanium precipitated by caustic potassa. These were dissolved in nitric acid after being thoroughly washed, evaporated to dryness, and heated in a platinum crucible until all the nitric acid was expelled. The oxides remained of a light reddish brown color, and were transferred to a glass containing nitric acid diluted

* From its concealment hitherto in the compounds of Cerium.

with 60 to 80 times as much water. After digesting about two hours in a gentle warmth, the latanium was dissolved and oxide of cerium remained of a reddish-brown color. The solution treated with caustic potassa threw down the white hydrated oxide of latanium, much more bulky and gelatinous in appearance than alumina. It is exceedingly difficult, if not impossible, to wash it out thoroughly, for after edulcoration for several days, the liquid passing through the filter still gave indications of solid matter, and almost led to the belief that the oxide was slightly soluble in water.

On redissolving hydrated oxide in nitric acid, evaporating to dryness, and heating to redness, the dry oxide remained of a brick-red color, differing therefore from the oxide of cerium by a lighter hue, and by containing less of a brownish shade. On treating this oxide as before with very dilute nitric acid, a small portion of oxide of cerium remained, proving that this mode of separating the two metals is not accurate, and that we must await farther experiments for the discovery of a more perfect method.

Carbonate of latanium, as thrown down by carbonate of soda, is a voluminous white precipitate, and, like the hydrated oxide, very difficult of edulcoration, for after obtaining the chloride from it, crystals of common salt were also visible. Agreeably to the observations of Mosander, therefore, the carbonate of ammonia is the best precipitant.

Sulphate of latanium is readily formed by the solution of the oxide, or carbonate, in dilute sulphuric acid, evaporation to a small bulk by heat and exposure to self-evaporation, while delicate needles of a flesh-red color collect in little groups on the bottom of the capsule.

The chloride is similarly formed by means of chlorohydric acid and evaporation. It forms a light yellowish green crystaline mass, in which no determinate form was observed.

The quantity of latanium in our possession was so small, amounting only to a few grains, that the operations were necessarily conducted slowly, and prevented our pursuing them quantitatively. Should we be enabled to obtain a larger amount, we may give more interesting results, without, however, trespassing on the field legitimately belonging to the discoverer.

Notice of the advances made in the Science of Mineralogy during the year 1837. *From the Report of Berzelius to the Swedish Academy.*

(Continued from page 301.)

*Schrötter** examined a mineral from Döllenberg, which he called Opalin-Allophane. It has no determinate texture, is light emerald-green passing into light brown, has a glassy lustre, white streak, is semi-transparent, has a sp. gr. =1.985—2.016, gives off water before the blow-pipe, fusing neither alone nor with soda, and consists of:

Silica,	11.95
Alumina,	46.30
Oxide of Iron,	2.95
Lime,	1.30
Sulphuric acid,	0.78
Oxide of Copper,	0.25
Water,	36.20
	99.73

* Poggend. Annal. XLI, 380.

Its formula is $A^2\ S\ Aq^4 + 2\ A\ Aq$ or $A^4\ S + 6\ Aq$.

*Glocker** gave a full description of Halloisite from Mechomitz, in Upper Silesia, together with an analysis of the same by *Oswald*, according to whom it consists of:

Silica,	40.25
Alumina,	35.00
Water,	24.25
Magnesia,	0.25

It contains a trace of manganese, and corresponds to the formula $A\ S^2\ Aq^2 + A\ S^3\ Aq^3$.

Beyrich† examined accurately the crystaline form of Phenakite, and confirmed the description of it as given by Norkenskjöld.

Brooke‡ described a well formed crystal of Pyrosmalite from Nordmarken. It is a regular six-sided prism, with terminal planes, the edges of which are replaced by two planes, the upper forming an angle of 148° 30′, and the lower one of 129° 13′, with the terminal plane.

Von Holger§ asserts that *Agal matholite* has such genuine characters of a magnesian silicate that they who analyzed it without finding magnesia, did not understand the method of separating this earth from Alumina. Among these inexperienced chemists we unexpectedly find Klaproth and Vauquelin, besides Lychnell, who gave the last analysis (Report, 1836). V. Holger who asserts that he analyzed a true Agalmatholite, and found it composed of:

Silica,	61.0
Magnesia,	25.4
Lime,	3.0
Alumina,	5.0
Protoxide of Manganese,	0.9
" of Iron,	4.3
	99.7

This composition belongs to the Talcs. That Klaproth, Vauquelin and Lychnell knew how to distinguish magnesia from alumina might perhaps be assumed with more certainty than that V. Holger could discern a compact talc from agalmatholite. It is remarkable how nature often replaces soundness of judgment by a firm conviction of one's infallibility. * * *

Breithaupt gave the name of Perikline to one of the soda-felspars, from its diminished specific gravity and a slight variation in the angles. *Thaulow*‖ analyzed it and found its composition to be:

Silica,	69.00
Alumina,	19.43
Soda,	11.47
Lime,	0.20
	100.10

This gives the formula $N\ S^3 + 3\ A\ S^3$ which is the same as that of Albite.

* Poggend. Annal. XLII, 173.
† Poggend. Annal. XLI, 323.
‡ L. & E. Phil. Mag. XI, 261.
§ Zeitschrift für Physic E. v. Baumgartner, V. 1.
‖ Poggend. Annal. XLII, 571.

G. Rose* examined it and found the angles varying from Albite, but referred the difference to striæ and curves on the surface of the former. There remained then the sp. gr., which with Albite is 2.61 to 2.63, and with Perikline is 2.437 to 2.457. But when it was pulverized it gave 2.637—2.647. The sp. gr. of powdered Albite was not determined. Here is another of Breithaupt's new species lost, and how many more will follow? I am far from undervaluing his minute investigation of the external characters of minerals, but like every superficial research, it is reprehensible to consider it as any thing more than a guide to examine whether such variations arise from real differences, and permit the establishment of new species.

Dufresnoy† described a mineral under the name of Gedrite which occurs as pebble near Gedre. It is clove-brown, crystaline, partly fibrous and partly foliated, scratches glass, but is scratched by quartz; sp. gr. 3.26. According to his analysis it contains:

Silica,	38.811
Alumina,	9.309
Protoxide of Iron,	45.834
Magnesia,	4.130
Lime,	0.666
Water,	2.301

Which necessarily gives the formula

$$\left.\begin{matrix} mg \\ C \end{matrix}\right\} S^2 + 6 f S + 2 A S,$$

and appears to belong to the varieties of Hypersthene.

The mineral described as Davidsonite (Report, 1838), was analyzed by Lampadius‡, and found to contain a variety of emerald.

The species of Asbest from Sterzing, in Tyrol, long since known under the name of mountain-wood, was analyzed by *Thaulow*§ who found its constituents to be:

Silica,	55.505
Peroxide of Iron,	19.442
Magnesia,	14.500
Lime,	0.100
Alumina,	0.040
Water,	10.260

This gives the formula $mg\ S^3\ Aq^3 + F\ S^2\ Aq^2$. Thaulow gives the chemical formula $(Fe^2\ 0^3 + 3\ Si\ 0^3) + (3\ Mg\ 0 + 2\ Si\ 0^3) + 5\ H^2\ 0$, but it is evident that a basic salt with a stronger base cannot be chemically combined with a neutral salt of a weaker base, and that the neutrality must be transferred to the combination of the stronger, which is applicable in this case.

Hausmann‖ described crystals of turmaline from Sonnenberg, near Andreasberg. They offer the first decisive example, in which surfaces of a flatter rhomb are found on that end of the crystal exhibiting electricity in cooling, and scalenohedral surfaces on the other end. The planes are matt on the former and shining on the latter.

Turner,** whose death, during the past year, science is called on to lament,

* Poggend. Annal. XLII, 575.
† Journal für Pract. Chemie. XI, 129.
‡ Journal für Pract. Chemie. X, 249.
§ Poggend. Annal. XLI, 635.
‖ Poggend. Annal. XLII, 580.
** L. & E. Phil. Mag. XL, 36.

examined the green particles, which communicate the same color to green sand. They consisted of:

Silica,	48.5
Protoxide of Iron,	22.0
Alumina,	17.0
Magnesia,	3.8
Water,	7.0
Potassa,	a trace
	98.3

They appear, therefore, to be fine parts of a kind of Chlorite.*

A mineral from the marble quarry Marmorskoi known as Chlorite-spar, to which G. Rose gave the name of Chloritoid, was analysed by Von Bonsdorf,† who found it to consist of:

Silica,	27.48
Magnesia,	4.29
Protoxide of Iron,	27.05
" of Manganese,	0.30
Alumina,	35.57
Water,	6.95

From this Von Bonsdorf calculates the formula

$$\frac{f}{mg}\,S+A^2S+3\,Aq,$$

which varies from that derived from *Erdmann's* analysis (see Report 1837, p. 176.)

COMMITTEE ON MINERALOGY.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on the Imperfect Elasticity of Glass Threads used in Torsion Instruments. By W. H. GOODE, *Chemical Assistant in the Laboratory of the University of the city of New York.*

From the superior elasticity which glass enjoys over most substances, particularly the metals, threads of this material have replaced the metallic wires with which the needles of torsion instruments were at first suspended. The late Dr. Ritchie employed them in his improved torsion galvanometer, which emulates the torsion balance of Coulomb, for accuracy in measuring small forces. It is necessary, however, to the perfection of torsion instru-

* The external resemblance of portions of the green sand of Europe to those of our states, and the similarity of composition, according to the analysis of Berthier and others, taken in connexion with the small amount of alumina and the greater proportion of potassa in our own, would seem to refute the opinion of Berzelius relative to their chloritic nature or origin. Nor does the opinion of Prof. Hitchcock appear to us better founded, that the constituents of green sand are not chemically combined, although we do not conceive them to be united according to the same atomic formula. *Com. Min.*

† G. Rose's tour to the Altai and the Caspian Sea, I, 252.

ments, that the elasticity of the thread of suspension, though a feeble, should be a constant force; and also that the thread itself should suffer no alteration of its conditions by the amount of force exerted upon it. Perfectly elastic substances only, fulfil these requirements; on all imperfectly elastic bodies torsion acts irregularly, and impresses a change upon them which prevents their return to their normal position, after it has been removed; such, for example, is the change effected in the conditions of metallic wires, filaments of silk, hair, &c., which, being imperfectly elastic, fail to return to zero when released from torsion.

The impression has become general that threads of glass, of a certain degree of tenuity, unlike the substances already mentioned, are not permanently affected by force exerted on them; but are capable always of regaining their original position; their elasticity is therefore considered to be perfect,—and measures effected with instruments to which they are adjusted, rigidly accurate. Having observed that the needle of a galvanometer suspended by a glass thread did not return to zero, after the instrument had been employed in a series of observations, it became a subject of inquiry to ascertain the source of error. For this purpose, threads of different diameters were suspended, in a manner similar in all respects, to that of a torsion balance. Two small uprights were placed on opposite sides of the little glass needle, near its opposite ends, which served as obstacles to it when torsion was made, and prevented it from rotating along with the micrometer. On some point of the thread, another little glass needle, carrying an upright arm, was cemented. This arm served as an index for the thread, and marked its position on a scale pasted on the opposite side of the jar; it was observed through a small hole in a plate of metal, placed ten or fifteen inches distant;—an improved method of observing a vertical index introduced by Professor Draper, London and Edinburgh Journal of Science, for October, 1839.

The thread being freely suspended, its index and that of the micrometer at their respective zeros, a torsion of three revolutions of the micrometer was exerted on the thread for five minutes; when released from this force it did not resume its position at zero, but varied from it in the direction opposite to that in which the torsion had been made. If the micrometer be now kept at zero, it will be found that the thread partially recovers itself, after the lapse of several hours; the amount of error is consequently diminished, but it never returns accurately to its original position. If instead of releasing the thread by returning the micrometer to zero, the thread be released from the obstacles, the same result will be obtained; in consequence of the impetus it acquires in spinning round, this latter is probably the less accurate method of observation.

A variety of experiments were performed with different threads, to ascertain if the alteration of the zero bore any constant relation to the amount of torsion employed. If such were the case, a system of compensation could be adopted which would free instruments fitted with glass threads from error.

The result of the observations made with one thread are given, for convenience, in a tabular form; they are analogous to those obtained with others; and indicate that the amount of the alteration of the zero, for the same threads, for different degrees of torsion, bears no constant proportion to the amount of force employed.

TABLE I.

	No. of degrees of Torsion.	Error of Zero.	Duration of Torsion.	Thermometer.
1	360°	2°	5′	70°
2	720°	10°	5′	70°
3	1080°	13°	5′	70°
4	1440°	20°	5′	70°

The thermometer was carefully noted in these experiments, lest the temperature of the room should vary during the prosecution of them; for it is not known what influence changes of temperature may exert on the elasticity of glass. After a lapse of twelve hours the thread had not returned to zero: another zero being assumed the following table of errors was obtained.

TABLE II.

	No. of degrees of Torsion.	Error.	Duration of Torsion.	Thermometer.
1	360°	2°	5′	70°
2	360°	3°	5′	70°
3	360°	3°	5′	70°
4	720°	6°	5′	70°
5	1080°	9°	5′	70°
6	1440°	12°	5′	70°

The thread was now left freely suspended for two hours; another needle and index were then adjusted to it, parallel to the first, but at twice the distance of the first from the micrometer: two points of the thread could now be observed and the effect of torsion on a double length noted. Up to 1080° the error of its two indexes was the same in amount; for that degree of torsion, the farther index varied more from its zero than the nearer, and consequently required the micrometer to pass through a greater space to restore it to that point. For a torsion of 1440° the error of the more distant index from the micrometer exceeded that of the nearer, three degrees. The tabular results are as follows:

TABLE III.

	No. of degrees of Torsion.	Error.	Duration of Torsion.	Thermometer.
1	360°	3°	5′	70°
2	720°	6°	5′	70°
3	1080°	6°	5′	70°
4	1440°	*	5′	70°

* Upper Index 5°. Lower one 8°.

The result indicated in the last experiment of the preceding table, has been observed to take place repeatedly when high degrees of torsion have been employed and continued for a long period. It is probably due to slight inequalities in the diameter of the threads and to their being differently annealed in different portions of their length; force exerted on them would, under such circumstances, produce more decided effects on some portions

than on others, and the effort made by the thread to recover itself would also occasion in different parts of it, different degrees of error.

An inspection of these tables will show that the whole amount of error, for each series of observations, is decreasing; in the first it amounted to 20°, in the second to 12°, in the third to 6°. It would therefore appear that a certain amount of torsion could be exerted on the thread for a certain period, for which it would afford no error of the zero. One thread which has been operated with, exhibited this effect of force exerted on it, in a very marked manner; for a torsion of two revolutions of the micrometer, its zero altered 10°, but for four revolutions there was no alteration. It was broken in making another observation.

For degrees of torsion less than that at which this effect takes place, the error of the zero will continue to exist; as it is observed, in the two last tables that for one and two revolutions of the micrometer, the error is nearly constant.

It has been shown that a force amounting to one revolution of the micrometer exerted for five minutes, produced a permanent deflectionof the zero of the thread, two degrees. An attempt was made to ascertain the influence of smaller degrees of force on the thread, exerted for a longer period. A torsion of 270° produced, in five minutes, a permanent deviation of the zero of $1\frac{1}{4}$°; 180° of torsion in the same period occasioned no error. A torsion of 90° continued for half an hour, produced an alteration of 2°; for 45° of torsion continued one and a half hours, it altered 3°. The permanent alteration of the zero of a glass thread appears to be occasioned, either by a large amount of force exerted upon it, or by smaller forces acting for a comparatively long period. The amount of this alteration is modified by a variety of circumstances; the diameter of the thread—the uniformity with which it cooled in being drawn—the amount of force to which it has been subjected, and its duration—combine in producing this effect; which, influenced by so many causes, must necessarily be variable in amount,

It is not probable that any two threads will afford the same numerical value of their respective errors of zero, for the same force exerted on them. We cannot be certain that they are in precisely the same condition—that they are identical in composition, or that they are equally well annealed. Both, however, will fail to return to zero after a certain amount of torsion has been exerted on them, by a quantity which diminishes for every series of observations; and which for a certain amount of torsion, becomes nothing.

The effect of this error of the zero on instruments constructed for the purpose of measuring small forces by torsion, is to cause the deviations of the needle, when the thread is newly suspended to be less than they ought to be, and less than they ever are afterwards; in each succeeding observation the force acting on the needle has to overcome not only the forces which keep it in equilibrio, but that also which deflects the thread from its zero; as this latter increases with the increase of torsion and with the time it occupies, the last deflections of the needle are much less than the first of the same series.

This kind of error will be found in every series of experiments, though it will vary in amount; but it will still be sufficient if not corrected for, to vitiate results requiring to be obtained accurately. In using torsion instruments, after each observation, the error of the zero ought to be ascertained and the due correction applied. But where it can be done, it is advisable first to ascertain the amount of torsion necessary in five minutes to cause an alteration of the zero; and then to ascertain the period of time which that

amount of torsion intended to be employed requires to produce the same effect, and not transcend these limits, by employing a greater amount of force on the thread, or using the instrument continuously for a longer time than it will afford correct measures.

Determination of the Longitude of Dover, Tuscarawas county, Ohio, from the Astronomical Observations of Mr. J. Blickenderfer, Jr. *By* Sears C. Walker.

Philadelphia, November 27th, 1839.

To the Committee on Publications.

Gentlemen,—I have compared Mr. Blickenderfer's Observations, published in the last number of the Journal, with corresponding observations made in the Atlantic Cities, and find for the longitude of his place of Observation at Dover, Tuscarawas County, Ohio, west of Greenwich, the following results:

From the Annular Eclipse of the Sun, Sept. 18th, 1838, as reduced by E. O. Kendall, by comparison with

Philadelphia,	Begin.	5h 25 53.92		
	F. R.	45.72		
	R. R.	58.44		
	End.	59.13		
	mean		5h 25m	54.30s
Princeton,	Begin.	48.02		
	F. R.	40.76		
	End.	67.75		
	mean with double weight to end.			56.07
Washington,	Begin.	55.46		
	F. R.	48.72		
	R. R.	62.87		
	End.	63.49		
	mean			57.64
Haverford,	Begin.	55.68		
	F. R.	46.46		
	R. R.	60.89		
	End.	56.72		
	mean			54.94
Southwick,	Begin.	51.79		
	End.	55.29		
	mean			53.54
	mean result by this Eclipse,		5 25	55.30

From the Immersion of η Pleiadum, Dec. 27th, 1838, as reduced by myself by comparison with

Philadelphia,	Im.	5 25 55.97	
Princeton,	Im.	55.85	
Southwick,	Im.	54.00	
	mean		5 25 55.27

From the Immersion of f, Pleiadum, the same evening, by comparison with

Philadelphia,	Im.	5 25 55.99	
Princeton,	Im.	59.24	
Boston,	Im.	56.30	
Breslaw,	Im.	61.09	
	mean		5 25 58.15
	mean by η and *f* Pleiadum,		5 25 56.71
	result by the Eclipse,		" 55.30
	longitude of Dover,		5 25 56.00

The latitude of Dover as given by Mr. Blickenderfer, is 40° 30′ 52.″

The longitudes of the places of comparison on which these results rest are, from Greenwich,

	h.	*m.*	*s.*	
Philadelphia State House, . .	5	0	39.	West.
Princeton, Prof. Alexander's House,	4	58	39.	"
Washington Capitol, ...	5	8	6.	"
Haverford School, Pa.	5	1	15.	"
Southwick, Mass.	4	51	16.	"
Breslaw Observatory, Germany, .	1	8	10.4	East.

By inspection of Mr. Tanner's Map, for 1837, it appears that the longitude of Dover is 17*m.* 54.2*s.* west of the Capitol, which gives its longitude 5*h.* 26*m.* 0.2*s.*, or 4 seconds of time, or one minute on the parallel of 40.°5, or finally about three fourths of a mile too far west. On reducing the moon-culminations observed in 1835, by Capt. Talcott, late of the U. S. Engineers, it appeared, that in the same map, Turtle Island, Lake Erie, latitude 41° 45′4″, had been placed in longitude 5*h.* 33*m.* 26.2*s.*, which is 5.6s too far east, its true longitude being 5*h.* 33*m.* 31.8*s.* Also, South Bend, or the southernmost point of Lake Michigan, latitude 41° 37′ 6″, was placed on this map in longitude 5*h.* 48*m.* 57.1s., which is 21.4s. too far east, its true longitude being 5*h.* 49*m.* 18.6*s.* In making this comparison I have corrected this map for the error in the assumed longitude of the prime meridian, that of the Capitol, which it is well known, is set down about 24 seconds in time, or 6 minutes on a parallel of 38°.9, or finally about 4½ miles, too far east. The errors of Mr. Tanner's map are certainly much less than would have been expected; when we consider the smallness of the number of astronomical observations which have served for its basis. This poverty of data for perfecting our maps can only be removed by such voluntary contributions as those of Mr. Blickenderfer. It is much to be wished that Geographical Engineers, most of whom are possessed of instruments adequate for the purpose, would follow the example of Mr. Blickenderfer, and forward their observations for publication. It often happens, that more depends upon the observer than the instruments. In the present instance, the results of the 18th September, and 27th December, present as close a coincidence as could have been expected in a fixed observatory. SEARS C. WALKER.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER, 1838,
With Remarks and Exemplifications by the Editor.

1. For an improvement in the *Machine for Pressing Bricks from Dry Clay;* Benjamin H. Brown, city of Washington, December 8.

This machine is, in its general construction, similar to that patented for

the same purpose by Mr. Nathan Sawyer; but there are certain points of difference, which, it is the intention of the present patentee to secure. The moulds are to be filled from a hopper which contains the pulverized clay; said hopper is made to slide back and forth, and passes in over the mould after the pressing piston has been raised, and the pressed brick removed, which is effected by the advance of the hopper. Instead of the provision adopted by Mr. Sawyer for having a sufficient quantity of clay at each end of the mould to make the angles of the brick perfect, there are two small condensing pieces which condense the clay at the two ends of the mould, and are withdrawn to allow the space made by them to be refilled, before the descent of the piston. The claims are to "the manner of constructing the hopper for filling the mould, by which construction it is made to tilt as it advances, still keeping its back edge in a position to receive the clay from the inclined plane, whilst the mould is filled through the opening, under the foot [of the hopper] and the pressed brick pushed off by it. Also, the provision for condensing the clay in each end of the mould, preparatory to the pressing of the brick; that is to say by means of the two condensers as described."

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2. For a machine for *Punching and forming the eyes of Axes, Hatchets, &c.;* Elisha K. Root, Collinsville, Hartford county, Connecticut, December 10.

This machine is, from its nature, one of too much complexity to admit of a clear description without the drawing; its parts, however, appear to be as simple as is compatible with the proper performance of its office. The patentee states his object to be, "to cut, punch, and form in solid iron, at a single heat, or with great dispatch and accuracy, the eyes of axes and hatchets of various forms; whereby an important saving is made in the iron, coal, and labour, and the axe and hatchet eyes are rendered more perfect and uniform."

"The peculiar feature of my invention consists in using two punches, or chisels, at the same time, to punch the same axe or hatchet eye, instead of one, and in punching by the force of pressure instead of by the force of blows struck by hammers, weights, or the like. The combined action of the two punches compresses the heated iron less, and divides it more exactly and equally into opposite cheeks than is practicable with one punch, and leaves a better shaped eye to finish on the eye pin."

"What I claim as my invention in the machine herein described, is the arrangement whereby a pair of punches, or chisels, are made to operate simultaneously on the opposite sides of the iron, so as to meet each other in the body thereof; and this I claim, whether the punches, or chisels, be driven by means of cams, levers, and punching slides, in the manner described, or in any other way producing the same effect by analogous means. I claim, also, in combination with the punches, or chisels, operated on as aforesaid, the jaws, or champs, for holding the iron centrally. I likewise claim, in combination with such punches, or chisels, the stands, or projections, at the front of the punching slides, constructed and operating substantially as described. Not intending, by these claims, to confine myself to the precise mode of construction herein set forth, nor to the using of all the parts described, as some of them may be omitted, whilst the main feature of my invention is retained; namely, the punching of the eyes of axes, hatchets, &c., from the two sides of the iron simultaneously, thus dividing the iron more equally, and more uniformly, and making better eyes than can be

formed by a single punch, or chisel, or by the force of blows applied to punches, or chisels, in the ordinary way."

3. For an improvement in the *Manufacture of Carpeting and Rugs;* John Humphries, city of New York, December 10.

The claim made is to "the attaching to the back or bottom of carpeting and rugs, known and designated by the names of brussels, brussels back, wilton, royal wilton, saxony, embossed imperial, and imperial, made with any material whatever, an additional ply, rib, knit substance, or body of material of warp and weft, as described." The additional ply is represented as a very stout thread, or cord, which is laid transversely upon the bottom of the carpet, and is secured to it by means of threads passing alternately over and under the respective strands in the weaving; the additional ply stretches along in straight lines, not being in any degree drawn into the body of the carpet.

4. For an improved *Machine for dressing Mill Stones;* Zebulon Cheesborough, Alden, Erie county, New York, December 10.

A chisel, or chisels, suitable for facing, dressing, or furrowing mill stones, is affixed to the end of a hinged, or jointed, arm, which may be raised up and down by hand so as to strike upon the stone. The hinge of said arm is made to slide back and forth upon a round steel rod, constituting the joint pin, allowing the chisel to be carried correctly along the line of a furrow. The whole is attached to a bed, or carriage frame, which is to be laid upon the stone, and kept in place by weights; there are proper provisions made for adjusting the length of the arm, and other parts. The claim is to "the combination of the chisel stock, with the axis-rod and carriage, as described."

5. For an improved *Sofa Bedstead;* Nicholas McGraw, city of New York, December 10.

Sofa bedsteads with sliding fronts, and falling backs, have been variously constructed, and all that remains to be claimed is the particular devices adopted by their makers, so far as the same may appear to be new; such are the claims in the present instance; the arrangements are made with skill and neatness, and the model in the office represents an elegant article of furniture.

6. For a *Corn Plough;* John Hernly, East Hampfield, Lancaster county, Pennsylvania, December 10.

The claim is to "the peculiar manner of constructing, affixing, and connecting the mould boards, so as to admit of their being shifted and turned so as to regulate the distance apart, and the breadth of the furrows."

7. For an improvement in the mode of *Smelting Iron ores;* Joseph Richards, city of Philadelphia, December 10. (See Specification.)

8. For *Heating the air for the hot blast in furnaces;* Joseph Jones, York, York county, Pennsylvania, December 10.

This patent is taken first, for the particular manner in which the pipes for heating the air are arranged in the heating oven at the tunnel head; the object being to increase the heating surface by the particular arrangement of the pipes, which arrangement is claimed. The second claim is to the

employment of the hot air conducting pipe, to open and close a damper in the chimney of the oven, which, operating upon a self regulating principle, closes the damper by its expansion, and prevents the passing of the flame from the furnace stack through the oven. The third improvement is in the manner of constructing a water tuyere, by casting it in two parts, so that the part exposed to the fire may be renewed at pleasure.

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9. For an improvement in the *Boilers of Locomotive and other Steam Engines;* Jacob Perkins, now residing in the city of London, December 15.

In this boiler there is to be a large number of tubes, which pass through its bottom, and extend down into the fire chamber, and up into the water of the boiler; these tubes are each to contain a quantity of water or other fluid, (water being preferred,) and they are to be hermetically sealed, so that the water contained in them cannot escape, but will be converted into surcharged steam, the heat from which is to be conveyed therefrom to the water within the boiler. The quantity of water in the tubes is to vary with the density required of the steam that is to be produced. "For steam and other boilers under atmospheric pressure, the quantity of water to be applied in each tube is to be about the one thousand eight hundredth part of the capacity of the tubes; for a pressure of two atmospheres, two one thousand eight hundredth parts, and so on for greater or less degrees of pressure, by which means the tubes will, when the boiler is at work, be pervaded with steam, and any additional heat which is applied, will rise quickly to the upper parts of the tubes, and be given off to the surrounding water." "What I claim as my invention is the combining a series of closed tubes, having quantities of water therein, which, in being heated, is expanded, and becomes the means of conducting any additional heat, which may be given off by the furnace to the water in the boiler, according to the principles above described."

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10. For apparatus for *Evaporating the extract of bark and other liquids*; George W. Klein, Boston, Massachusetts, December 15.

There is to be a vertical pipe, or tube, into which steam is to be admitted at its upper, and is to pass down to its lower, end, where the water produced by condensation is to be carried off by a discharge pipe, furnished with a safety valve. The vertical steam tube is to be surrounded by a spiral trough, descending like the thread of a screw, from the top to the bottom, and the extract to be evaporated, is to be made to run down this trough, of which the steam tube constitutes one side. The whole is to be inclosed within a wooden box, or case.

Claim. "I claim as my invention and discovery this mode of evaporating liquids and infusions of bark, or other astringent matter used in the manufacture of leather. I claim, also, an evaporating apparatus constructed and operating in the manner, and on the principles, I have set forth, for said purposes."

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11. For *Locks for Trunks, Chests, &c.;* Henry C. Jones, Newark, New Jersey, December 15.

This lock bears a near resemblance to locks which we have seen of German manufacture; there are to be two spring bolts, which, when the trunk, &c., is shut, catch upon, and embrace, the piece which is attached to the lid, and which enters the lock in the manner of the ordinary staple in desk locks.

The key is made to act upon levers, which open the two spring bolts simultaneously. The claim is to "the employment of two levers, which act upon the jaws of the catches in opening the lock, in the manner described." We do not, in this lock, perceive any thing calculated to attain the object of special security, but think that it might be picked with considerable facility.

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12. For an improved *Spark Arrester;* Benjamin Briscoe, city of Detroit, Michigan, December 15. (See Specification, at p. 236.)

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13. For a *Spark Extinguisher*; Samuel Leonard, Bridgewater, Plymouth county, Massachusetts, December 15.

The upper end of the smoke flue is to be surrounded by a trough containing water, and above the opening of said flue there is to be a revolving bell-formed, or conical, cap, having its open mouth downwards, and of such diameter beyond that of the flue, as to double the capacity for the draught. On the inside of this cap there are to be wings, or vanes, which by their revolution are to throw the sparks down into the water, whilst they are intended at the same time to increase the draught.

CLAIM. "What I claim as my invention, and desire to secure by letters patent, is a conical cap, or bell, with wings, or fans, revolving over the top of the funnels of locomotives and steam-boats, and other funnels, to cause a sufficient draught, and extinguish the sparks proceeding from them, by throwing them into water; and also a vessel surrounding the funnel to contain water to extinguish the sparks, and to heat the water, by which the engine may be supplied, in a manner substantially the same with that herein fully set forth."

This is not the first contrivance made for the purpose of throwing the sparks down into a vessel of water, and the patent is not granted for this object, but for the particular manner of carrying on this and the other operations described in the specification. We have not received any information respecting the practical operation of this apparatus, but as the efforts are still continued to find the means of extinguishing the sparks from locomotive engines without injury to the draught, we apprehend that it has not been satisfactory.

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14. For a machine for *Cleaning Grain;* George A. Johnson, Johnsonburg, Genessee county, New York, December 15.

The grain is to be let into a horizontal metallic cylinder, roughened on its interior, by punching from the outside. Within the cylinder there is a revolving shaft carrying arms on a vane, by which the grain is thrown forcibly against its interior, and is thus acted upon from the point of admission at the upper part at one end, to that of escape at the lower part of the other.

CLAIM. "What I claim as my invention in the above described machine, and which I desire to secure by letters patent, is the manner in which I construct the revolving apparatus within the cylinder, consisting of the open head with the vanes attached thereto, and the arms or wings in combination with each other, operating in the manner and for the purpose herein set forth."

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15. For a machine for *Doubling and twisting Silk;* Jonathan Dennis, Jr., Portsmouth, Newport county, Rhode Island, December 28.

"The nature of my invention consists in spinning and twisting the silk from the cocoons, at the same time, upon one machine, that is so constructed that when part of the spindles are spinning, the others are doubling and twisting that which has already been spun;" the particular construction of this machine we shall not take time to point out, but merely add the claims, which are to "the combination of the flyers and spindles with the guides and hands of pointed wires, and the wheel (to which friction is applied,) over which the silk passes in doubling and twisting, in combination with the macerating cup, and with the flyer and spindle as described."

"The hands of pointed wires," mentioned above, are to prevent the rising of the tangled cocoons from the water.

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16. For improvements in the machine for *Reeling Silk from Cocoons;* Jonathan Dennis, Jr., Portsmouth, Newport county, Rhode Island, December 28.

It will be seen by the subjoined claims, that the improvements which are the subject of this patent do not essentially alter the construction of the reel. They are, "1st. The hand of pointed wires or fingers to prevent the cocoons from being drawn so near to the guide as to allow the tangled fibres to be twisted in with the others and break the threads of silk; and, 2nd. The fluted ends of the twisting tubes with the guides and hands, as described."

The fluted tubes above mentioned, have the silk passing through them on its way to the reels, and these tubes being made to revolve rapidly, unite the fibres in their passage, and enable the tender of the machine to apply new fibres with facility.

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17. For apparatus for *Extinguishing sparks and arresting cinders in the chimneys of Locomotives;* John Finlay, city of Baltimore, December 28.

This apparatus is similar in principle to, but different in arrangement from that described at No. 13, of this list. A wheel, like a ventilator, is placed near to the rear of the smoke box, and occupies the part leading from it to the chimney. This wheel is fixed upon a horizontal axis, and the edges of its vanes are to dip into a trough of water, which, by the rapid revolution of the wheel is to be thrown into spray, which is to produce the effect of extinguishing and arresting the sparks. The shaft projects through the back of the smoke box, and is driven by any suitable means.

CLAIM. "Now, what I claim as my improvement, and which I desire to secure by letters patent, consists in the use and application of a ventilating or a fan wheel, revolving through the water contained in a water case, thereby extinguishing and arresting the upward tendency or escape of sparks and cinders—they being thrown downwards into the water case, and the smoke only escaping through the chimney, or stack. The whole constructed substantially in the manner herein described, and represented in the accompanying drawings."

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18. For improvements in *Flyers and Spindles for spinning and twisting Cotton, &c.*; John Howarth, and Nathan F. Jones, Andover, Essex county, Massachusetts, December 28.

The claims under this patent are to "the supporting the top of the spindle during its vibrations up and down in an elongated tube, whether the

spindle be provided with a roller at the end fitting into the tube, or passes through a collar firmly fixed in the inside of the tube; the manner of applying the friction to retard the spindle; and the manner of retarding the spindle, spool, or bobbin, by a rectangular piece of metal or other material attached to the same, and operating against the atmosphere when in motion, the resistance of which creates a uniformity in the retardation of the same."

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19. For an improved *Lantern for Steamboats*; John M. Read, Louisville, Jefferson county, Kentucky, December 28.

The lantern which is the subject of this patent has but little, if any thing, of novelty in its construction, as will be seen by the claim, which is to the "covering the front of the lantern with a hollow frustum of a cone or pyramid, in order to obscure the light in every direction except directly in front." Now this tube is so much like that used in the magic, and some other lanterns, as, apparently, to deprive it of every feature of novelty, should it not be found that a device so obvious in its character had been otherwise applied, of which there can be but little room to doubt.

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20. For an improved *Brick Press;* Stephen Ustick, city of Philadelphia, December 28.

The patentee says, "I construct a shaft which is to be permanently fixed in a vertical position, and of sufficient strength to sustain all the working parts of the machine. Attached firmly to this shaft are two segments of cylinders which I denominate cam wheels, as, although they are in general stationary, they are intended to perform the office of cams, in a manner to be presently described. The upper and lower surfaces of these wheels at their peripheries, are so formed as, by elevations and depressions upon which friction wheels are to roll, to raise and depress the pistons, or followers, by which the pressing is to be effected, and to give to the pulverized clay which is deposited in the moulds, the pressure necessary to consolidate the earth. The stationary part of the machine, above named, is to be surrounded by a polylateral frame work which is to be made to revolve round the centre shaft, and is to have on each of its sides an apparatus consisting of a brick mould, or set of moulds, the pistons, or followers, by which the pressing is to be effected, together with such accessory parts as are necessary to complete the operation. The moulds in which the pressing is to be effected are open both above and below, there being two followers to each mould, one of which is made to rise as the other descends, so as to exert an equal pressure both below and above. The lower pistons constitute the effective bottom of the mould when it is being charged with the pulverized clay, and after co-operating with the upper pistons in pressing the brick, they are made to operate as lifters, rising to the upper surface of the mould, and presenting the brick, ready for removal, as the upper piston is withdrawn."

The patentee then describes his press by references to the drawings, and concludes with the following claims.

"What I claim as my invention is the manner in which I have combined and arranged the respective parts of my machine to produce the effect, as set forth; that is to say, I claim to be the inventor of a polylateral machine, furnished on each side with two vertical slides carrying pistons, or followers, for pressing both sides of the bricks simultaneously. Said frames being operated upon by circular cam wheels, either by the revolution of the outer frame, or of the shaft and cam wheels, the whole constructed and operating

substantially as herein described. It is to be understood, also, that, although I generally make my machines polylateral, a single press may be made on the same principle, and is therefore included as of my invention."

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21. For an improved machine for *Making Iron Sockets*; Leonard Morse, and Harvey Pettee, Foxborough, Norfolk county, Massachusetts, December 28.

After describing the apparatus used by him, the patentee says, that "by substituting dies, triplets, and mandrels, of different forms and sizes, this arrangement may be employed for making sockets of any required form or proportions, from the thicker, stouter, and heavier, to the thinnest, lightest, and most delicate, according to the uses to which they are to be applied." Those shown in the drawing are such as might be attached to hoes, or to similar articles. The machine consists mainly of a hammer, operating as a trip hammer, its face being properly formed to strike upon the socket, the anvil forming the lower half of the die, and the socket being held upon a mandrel. The claim is to "the combination of the mandrel with the dies, and with the trip or tilt hammer, for the purpose, and in the manner, herein set forth."

There certainly is but little of novelty in such a machine, as the formation of various articles by analogous means is a thing well known; we think this case one of those, and they are numerous, in which the patent was granted upon a doubt of the propriety of refusing it, but without a clear conviction that the thing which it is desired to secure is substantially new.

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22. For an apparatus for *Condensing Steam and heating Air;* Asahel Collins, Ulster Village, Ulster county, New York, December 31.

This patent is taken for an apparatus for condensing steam by means of atmospheric air, and of applying the air after being heated, to the purpose of feeding the fire. There is a double drum, or case, divided into two compartments by a diaphragm, or partition; a shaft passes through the centre of this double drum, and carries two sets of vanes, one in each compartment of the drum. Into one of these compartments steam is to be admitted for the purpose of being condensed, and into the other atmospheric air; both the steam and air are to be forced out by the fans through a tangential pipe, within which, by their commingling, the steam is to be condensed and the air heated; from this pipe the air and water pass into a common receptacle, from which the water is to be conducted by one tube to supply the boiler, and the air through another tube to the furnace, to keep up the combustion.

The condensing by atmospheric air is not claimed, but the claim is to "the condensing of steam by atmospheric air by means of a revolving fan, and the heated air thus produced used as a supporter of combustion; and the application of the mercurial gauge as a regulator of combustion; these severally produced by the manner before described, or in any other mode or manner substantially the same."

The mercurial gauge, mentioned in the claim, is intended to operate so as to act upon the ash pit door, or upon a valve, to regulate the heat, but the particular method of doing this is not described, or represented in the drawings.

The whole arrangement, taken in connexion with the description, appears to be crude and undigested, and does not offer any thing likely to be of practical utility; and we are well assured that it would not, in its present

form, have been made the subject of a patent, had it been essayed practically before making the application for one.

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23. For an improvement in the *Platform Balance;* Robert L. McCollum, city of Rochester, New York, December 31.

The modifications of the platform balance which have been made the subjects of patents are numerous; the present is taken for the particular manner of making the suspension, the claims being to "the resting of the feet of the platform upon the tops of rings suspended upon edges, and moving with perfect freedom upon them, so that the ring will always adjust itself in such a manner that the bearing of the platform shall be directly over the edge; and a similar adjustment of the other bearing points of the machinery of the balance, all as described."

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24. For a *Machine for throwing Balls, Shot, &c.,* Robert McCarty, city of New York, December 31.

This machine is described as a metallic, cylindrical case, about one and a fourth inch deep, and three feet in diameter, in its interior. It is to be placed, either horizontally or vertically, on a suitable stand, which will admit of its direction being changed. A hollow shaft carries a revolving arm, or arms, within this case, and the balls are to be dropped in through a funnel, or hopper, in the centre, whence they are carried round spirally by the revolving arms, and are delivered at the periphery of the drum through a tube intended to give them a proper direction. The claims made, are to "the throwing of balls, shot, &c., by the combined action of centrifugal and projectile forces, as set forth, without reference to the particular form of the propelling arms, or face plate, by which the same are projected."

The arms are, of course, to be made to revolve with great velocity, as the velocity of the ball must be determined by that of the end of the arm. We are decidedly of opinion, that this machine will utterly disappoint the sanguine anticipations of its projector and of many others, who, upon witnessing the partial trials made with it, have deemed it a very important invention, and have entertained an idea that a continued stream of balls may be thrown by it with the utmost facility. It belongs, however, only to those who are incapable of applying the proper analysis to arrive at such a conclusion. The throwing by centrifugal force, like the throwing by any other force, will require the application of all the power necessary to give the proper momentum to the masses of matter to be thrown, and may be made the subject of direct calculation; and we are assured that such calculation would result in a direct proof of the inadequacy of this apparatus, under any conditions which could be practically applied. What is intended by "the combined action of centrifugal and projectile forces," as applied to this machine, we do not understand.

Were there no radical objection of this kind, we think that it would still be very difficult to point out the situation in which such a machine could be advantageously employed; in our own country it would, most certainly, be impossible so to do.

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25. For a Machine for *Cleaning Cotton;* Jacob Idler, city of Philadelphia, December 31.

The patentee calls this machine a *repeating cotton cleaner,* and the sub-

joined claim will afford a sufficiently distinct idea of its general construction and mode of operation.

"The invention claimed and desired to be secured by letters patent, consists in the before described combination of two, or more, transverse parallel cylinders of bill hook teeth, made from separate plates of metal, each containing six teeth, more or less, working in spaces between the teeth of the several cylinders, with longitudinal, parallel, concave bars, armed with triangular, or other, teeth, placed under the first and second cylinders, between which the bill hook teeth work; and a concave of wire net-work, and transverse rows of inclined teeth and perpendicular brushes, through which the bill hook teeth also work; and a curved finger grating in the bottom of the hopper, fastened to a hinged frame, raised or lowered as required by a lever, through which finger grating the teeth of the first cylinder work, in the manner described, for separating the trashy particles from cotton in the seed, preparatory to the ginning operation."

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26. For improvements in making *Weavers' Harness*; John Thorp, and William G. Angell, Providence, Rhode Island, December 31.

The claim will afford a sufficiently clear general idea of the improvement believed to have been made; it is as follows: "What we claim as our invention, and desire to secure by letters patent, is the addition of one or more eyes to each and every headdle, over and above the single eye, forming two, or more, tiers of eyes through each leaf of the harness, and the flattening of the knots for the purpose herein described, and the manner in which we fasten the twine, or headdles, to the back bands of the harness, as above described."

The flattening of the knots, it is said, may be effected in various ways, but its intention is, "that the threads of the warp may pass and repass them with more ease and less obstruction than they can when the knots are left in their natural shape." The increased number of eyes is intended "to make the harness more durable than the single eyed harness, it being the eyes that wear out before the other parts of the harness are injured by wear." The several webs are to be drawn first into one row, and next into another row of these eyes, to insure equal wear. Instructions are given how to proceed in making such harness.

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27. For *Drop Doors or partitions for rooms;* George Kilbrun, Walpole, Cheshire county, New Hampshire, December 31.

Partitions which may be made of panel works, or of light laths affixed together lattice-wise, and plastered over, are to slide within grooves in pillasters, or other suitable contrivances, and are to be raised by means of racks and pinions; the particular devices which may be thus employed are described and represented; the claims made, are to "the arrangement of the rising partitions, with the racks and pinions on the shafts to operate together, substantially as described. The constructing the rising partitions of laths or strips of wood laid on each other, and secured together and plastered, in the manner explained. The mode of finishing or completing the pilasters when the partition is raised, by small hinged portions of the same; also, the mode of finishing the soffit of the entablature by wedged strips."

There is certainly but little of invention in the proposed plan, most of the contrivances being of a very obvious character, and such as most workmen would resort to in the ordinary prosecution of their business, without

thinking themselves inventors. The raising of the partitions, or doors, by racks and pinions may, possibly, not have been before adopted, but the same device has been used for analogous purposes a thousand times.

28. For an improved *Water Wheel*; William Hatfield, Zanesville, Ohio, December 31.

This is said to be an improvement on Parker's Water Wheel, which was patented about ten years ago. It is one of the kind denominated the reaction and percussion wheel, and "the invention claimed, consists in the peculiar form of the buckets, and the double spiral scroll placed between them for directing the water, in the manner described," which form and manner, we believe, will make but little, or no, difference in its action, and we shall not, therefore, stop to explain them, as we should have to tell a long tale, which, after all, would be somewhat obscure without an inspection of the model, or drawings.

29. For *Managing the draught of Forges, Furnaces, &c.*, Asahel Collins, Ulster Village, Ulster county, New York, December 31.

The claim made under this patent, is to "the forcing of any required portion of the air, which has been exhausted, through suitable tubes or pipes, so as to supply heated air to the fire, in conjunction with such portions of fresh air as it may be found necessary to supply, the same being effected substantially in the manner set forth." The plan consists in making an inclosed ash pit, and in placing in the flue a fan wheel, which is to be made to revolve, so as to exhaust the air from the fire; a portion of this air is to be forced back into the inclosed ash pit, and there must, of course, be means adopted for admitting a fresh portion of air to keep up the combustion; the way in which this is to be done is not pointed out, but it was probably deemed sufficiently obvious.

A very similar device is noticed in Vol. XVIII, p. 320, of this journal, as patented by Mr. N. Lockling, and several others have been mentioned since the grant of Mr. Collin's patent, as having been previously known and used; we are not, however, prepared to say that they are precisely the same, not having had the time, or the means, for ascertaining this fact.

30. For an improvement in *Water Wheels;* Thomas N. and Joseph N. Whitcomb, Grafton, Windham county, Vermont, December 31.

The claim is, to "the giving to the curb the form of the frustum of an inverted cone, and adapting the buckets thereto." There is a vertical shaft, which, at its lower end, has buckets placed spirally around it, these buckets are contained in a curb of the form mentioned, their edges nearly touching its interior; this conical form of the buckets and curb the patentees imagine will greatly increase the power of the wheel.

31. For an improved apparatus for *Evaporating Saccharine and other liquids;* Samuel F. Harrison, city of Baltimore, December 31.

This apparatus consists of a number of boxes, or cases, which may be made of copper, and into which steam is to be admitted through suitable tubes. These boxes are shallow, but of considerable horizontal, or nearly horizontal, surface. Their upper sides are to be fluted, or corrugated, to cause any liquid passing over them to be retarded in its passage. They are placed with the inclination necessary for the descent of a fluid from one

end of the box to the other. There may be any desired number of such boxes acting in succession, high steam being admitted into the first, and said steam being successively conducted into the others. The apparatus is described with considerable minuteness, and represented in several figures. The following are the claims made.

"A patent is hereby claimed for the application of the above-described apparatus, or evaporator, in order to produce instantaneous, and continued evaporation of liquid, from a less to a greater density, by means of the multiplied application of steam, or vapour, through the use of several evaporators in one machine, as described in the above specification, whether the first evaporators be heated by means of the direct action of fire, by means of heated gas, or by means of the caloric of vapour; also, for the application of the principle, that steam may be heated to any greater degree, without increasing its tension, as above described."

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32. For a *Furnace for Manufacturing Iron*; Isaac C. Bryant, city of Philadelphia, December 31.

The patentee states that he constructs his furnace with several new features, and that he denominates it "the combined hot air blast furnace." He says, "I improve the furnace by constructing its inner walls above the customary bosh, or spreading and making a secondary bosh or enlargement of the interior of the furnace above the first or customary bosh, and above the said contraction. A second or third contraction, and a third or fourth bosh may be added if found expedient, the object being to diminish the pressure of coal on the lower or customary bosh, and the liability to wedging or compression of the coal at the lower part of the furnace when anthracite is used."

Another improvement is in making recesses, or grooves, on the inner surface of the furnace, extending vertically up from the crucible, in order to allow of the ascent of air, and to diminish the heat near the crucible; the manner of heating the air, is also varied from the methods heretofore pursued; and water tuyeres of a novel construction are employed. We must, however, refer to the following claims for the other particulars named in the specification. We have seen specimens of iron of very good quality made in this furnace, but we believe that the plan has been abandoned, or its use, at present suspended, as is the case with a number of the furnaces intended for smelting by means of anthracite.

Claim. "What I claim as my improvement, is,

"1st. The application of the contraction, and the second bosh with one, or more additional contractions and boshes, if deemed expedient.

"2nd. The application of the recesses, or grooves, for the purposes mentioned.

"3rd. The application of the air-heating chamber, surrounding the upper portion of the furnace, and the arrangement by which it is effected, the object being convenience, and economy of fuel; the said chamber being constructed and arranged in the manner set forth.

"4th. The use of an elongated opening in each of the water tuyeres, for the purpose already stated.

"5th. The use of boxes, or cases, containing water, constantly shifted by a current placed around the crucible, so as to absorb a portion of its heat, and increase its durability. These boxes may be made in number and breadth, only equal to the water tuyeres, or they may be increased either in number or in breadth, so as to form an entire circle round the crucible. Their size

and thickness may be varied as experience may prove to be expedient They may be extended in height, from the bottom of the crucible to the top of the square of the crucible.

6th. The combination of the above improvements, or new modes of construction, or of any one or more of them, with a furnace built in the ordinary manner in other respects, or in such a manner as may be chosen by the founder.

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33. For *Metallic frames for neck Stocks, and Cravat stiffeners*; John Johnson, city of New York, December 31.

These stiffeners are made of wire, which is so bent as to spring outwards around the edges of the stock; the contrivance appears to be peculiarly well adapted to stocks intended for wear in summer. The claim is to the manner of making such frames, as described, and represented.

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34. For an improved *Regulator for paper making engines;* John M. Hollingsworth, Braintree, Norfolk county, Massachusetts, December 31.

"In ordinary engines the gudgeons of the shaft of the beating cylinder rest in bearings attached to the upper faces of two beams, or *lighters*, the end of one of which is capable of being raised or depressed by a screw operating thereon. The object of the above improvement is to regulate the distance from time to time, between the cutting edges of the knives of the beater, and those of the knives of the block. As these regulating screws have heretofore been turned by the hand of the workman, or attendant on the engine, the same depending on his judgment, or skill, it will be evident that any neglect of duty, or want of necessary judgment on his part, has been of material disadvantage, not only to the converting of rags to the consistence of pulp, but to the interests of the paper maker." The machinery which forms the subject of this patent, is intended to correct this evil, and it was our design to give a general description of the apparatus, but we find that the matter would occupy more space than can now be afforded, as, though not absolutely complex, it still would be with difficulty rendered clear without the drawings. The claim is to the regulating the downward motion of the lighter by means of a cam, particularly formed for that purpose, and also, by means of an inclined plane acting on the lighter, or on the extremity of a pitman connected to the lighter, as set forth.

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35. For an improved mode of constructing the *Gaft of Sail Vessels*; John Brown, Stonington, New London county, Connecticut, December 31.

"My invention consists in providing a semi-cylindric saddle, to be affixed in the swallow tail of the ordinary gaft of sail vessels, and which in its use both strengthens the mast, and prevents the same from being chafed and worn by the swallow tail of the gaft." The saddle is to be made concave, and adapted to the mast, and it is to be attached to the gaft by a bolt passing through suitable eyes in the back of it, allowing a free motion, up and down to the gaft. The claim is to "the application of such a saddle to the swallow tail of a gaft, operating in the manner set forth."

Specifications of American Patents.

Specification of a patent for an improvement in the mode of smelting Iron Ores, and in the manufacturing of Steel; granted to Joseph Richards, *of the City of Philadelphia, December 10th,* 1838.

In smelting iron ores, the object is to produce a carbonate of iron; the process hitherto known as best adapted to this end is by using charcoal for the fuel, and limestone for the flux. The substitution of coke for the fuel, or any of the mineral coals, does not produce iron so highly carbonated as that which is smelted by the use of charcoal.

My improvement consists in the use of one, or more iron cylinders, or other vessels conveniently placed, and similar to the apparatus in common use for producing pyroligneous acid, and capable of containing compactly, half a cord of wood, or any other desired quantity; dry wood evolves more acid than green, and white oak is the best.—Vinegar, or acetic acid, may be used instead of wood, and the cylinder, or vessels, may be adapted to these substances.

The cylinders or vessels containing the wood or acids must be tightly closed, and furnished with a pipe that will conduct the gas evolved into a furnace above the blast. The cylinder or vessel must then be heated to a temperature that will disengage the gas, and drive it into the furnace. The gas from half a cord of dry white oak will continue to evolve for twenty-four hours. The use of clay, as commonly practiced, will hinder the gas from escaping out of the furnace, and it will be rapidly absorbed by the metal in the fusion, and cause it to have an increased affinity for the carbon evolved from the fuel and limestone, and the iron will be thus furnished with a full charge of carbon.

In converting iron into steel, the present process is by the slow operation of the carbon, which is disengaged from the charcoal, and is absorbed by the metal bars. My improvement consists in the direct use, application, or introduction of pyroligneous, or acetic, acid, in the gaseous state, into the steel furnace, in manner as aforesaid, which will cause the iron to have an increased affinity for the carbon evolved from the fuel, and which will thus become more rapidly charged with the carbon; my improvement will be found to be most useful, when coke, mineral coal, or fuel other than charcoal, is used in the steel furnace.

What I claim as my invention and discovery, and desire to secure by letters patent, is the direct use, application, or introduction, of pyroligneous or acetic acids, in a gaseous state, into the process of smelting iron ores, and in the manufacturing of steel. Joseph Richards.

Remarks by the Editor.—We apprehend that the above patent has been obtained upon hypothetical conclusions, and not after practical trial. The patentee is a skilful manufacturer of white lead, and he seems to have concluded that the vapour of vinegar, or pyroligneous acid will act upon the ores of iron in their reduction, and upon steel in cementation, as it acts upon the oxide of lead at the very moderate temperature at which that oxide is carbonated. We believe, however, that the fair deduction from what is known of chemical affinities relating to this matter, would be that the vaporous, or gaseous, acid, would not be absorbed by the heated metal, or in

any way contribute to its carbonization. The experiment, however, is one of no great difficulty, but we are not aware that it has been made.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the Strength and other Properties of Cast Iron obtained from the Hot and Cold Blast. By William Fairbairn, Esq.

[continued from page 345.]

The Elsicar and Milton being the only Yorkshire irons obtained answering to the description of hot and cold blast, it may be proper, in this part of my report, to state that I have been favoured with a series of experiments made at the Low Moor Works, near Bradford, by Mr Dawson, one of the proprietors. In the year 1830 the hot blast was tried in the reduction of the ores of the Bradford district. A number of bars, one inch square, were cast from iron produced in the cold blast furnace of 1829, and a similar number of bars were cast, of the same dimensions, and from the same model and furnace, with hot blast, in 1830. Each of the bars was broken with weights placed on the centre, and supported on beams, or bearers, three feet asunder. The results are below:

Mean breaking weight of the	Cold Blast bars	947 lbs.
Mean	do.	do.	Hot Blast bars	787 "
		Difference in favour of Cold Blast	160

being as 94 to 78 in the ratio of 1000 to 831, or nearly the same in favour of the cold blast as exhibited in the preceding tables.

It appears somewhat remarkable, that the same, or nearly the same, results should be obtained in my experiments of 1836, on the Elsicar and Milton irons, as were elicited in the experiments at the Low Moor in 1830. In both instances there is an obvious defect in the strengths of the iron made by the hot blast; and, judging from the difference in the deflections between the Elsicar and the Milton, I should consider the hot blast more *tender* than the Elsicar, and less worthy of trust than it, when submitted to forcible strain under vibratory action; the power to sustain impact being in favour of the former as 1000 to 875. Before closing these observations, I would venture to mention the striking anomaly that exists between the Yorkshire ores and those of other districts when operated upon by the hot blast. From the experiments generally, such a marked difference does not exist in the strength of other irons as are herein portrayed in those of Yorkshire. Some peculiar, and probably unknown, affinity in the minerals may be brought into action by the heated air; otherwise, I confess, I cannot perceive any just reason for such a change. The mere heating of atmospheric air to 600° or 700° before it enters the furnace, should not, in my opinion, differ so considerably from the same air heated in the furnace. I hope the results of these experiments will induce Dr. Faraday, Dr. Thompson, or some other eminent chemist, to inquire further into this subject, and, by correct analysis, to ascertain the cause of differences which at the present moment appear anything but satisfactory.

Table VII.—Scotch Iron.—Carron No. 3 Pig-Iron, Cold Blast.

Experiment 1. Depth of bar, 1.020 Breadth of do. 1.010 Distance between supports, 4 ft. 6 in.			Experiment 2. Depth of bar, .997 Breadth of do. 1.001 Distance between supports, 4 ft. 6 in			Experiment 3. Depth of bar, .995 Breadth of do. 1.005 Distance between supports, 4 ft. 6 in.			Experiment 4. Depth of bar, 1.024 Breadth of do. 1.000 Distance between supports, 2 ft. 3 in.			Experiment 5. Depth of bar, 1.008 Breadth of do. .999 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.
28	.068	..	28	.071	+	28	.070	+	112	.032	..	112	.032	..
56	.129	+	56	.140	.007	56	.138	.007	224	.067	+	224	.071	+
112	.253	.010	112	.278	.013	112	.270	.011	336	.100	+	336	.110	+
168	.401	.020	168	.430	.027	168	.422	.025	448	.137	.006	448	.149	.007
224	.552	.038	224	.590	.046	224	.587	.046	560	.177	.009	560	.189	.010
280	.718	.061	280	.755	.069	280	.749	.067	672	.215	.014	672	.233	.017
336	.890	.090	336	.946	.098	336	.928	.095	784	.258	.022	784	.280	.023
392	1.079	.120	392	1.142	.136	392	1.122	.132	896	broke		896	.337	.037
448	1.281	.169	420	1.249		420	1.223					952	broke	
469	broke		434	broke		448	broke							
∴ Ultimate deflection = 1.351. Broke 1 inch from the centre.			∴ Ultimate deflection = 1.297. Broke ½ of an inch from the centre.			∴ Ultimate deflection = 1.345. Broke 3-8 of an inch from the centre.			∴ Ultimate deflection = .297. Broke 1¼ inch from the centre.			∴ Ultimate deflection = .360. Broke ¼ an inch from the centre.		

Carron No. 3, cold blast, indicates (when viewed with a magnifier) an exceedingly close texture, with a rich, sparkling, gray colour. For No. 3 iron, it possesses more than usual softness, and yields freely either to the chisel, or the file. I should consider it in no way inferior to most No. 2 irons in relation to its power of being worked.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity	Modulus of elasticity in lbs. per square inch.	Breaking weight (b).	Ultimate deflection (d).	Product $b \times d$ or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports.	7054	16259100	446.3	1.410	629.3
Experiment 2nd, bar 4 ft. 6 in. between supports,	7135	15987300	436.2	1.293	564.0
Experiment 3rd, bar 4 ft. 6 in. between supports,	..	16494500	450.2	1.307	588.4
Mean,	7094	16246966	444.2	1.336	593.9
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	854.5	.3041	259.9
Experiment 5th, bar 2 ft. 3 in. between supports,	..	..	937.9	.3629	340.3
Mean,	..	..	896.2	.3335	300.1

TABLE VIII.—Scotch Iron.—Carron No. 3 Pig-Iron, Hot Blast.

Experiment 1. Depth bar .996 Breadth 1.002 Distance between supports, 4 ft. 6 in.			Experiment 2. Depth bar, 1.006 Breadth 1.015 Distance between supports, 4 ft. 6 in.			Experiment 3. Depth bar, .989 Breadth 1.001 Distance between supports, 4 ft. 6 in.			Experiment 4. Depth bar, 1.002 Breadth 1.002 Distance between supports, 2 ft. 3 in.			Experiment 5. Depth bar, .993 Breadth .998 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection load removed.	Weight in lbs.	Deflection in inches.	Deflection load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
28	.068	..	28	.067	..	28	.069	..	112	.032	..	112	.034	..
56	.128	+	56	.126	..	56	.132	+	224	.061	..	224	.069	..
112	.250	.006	112	.241	.006	112	.255	.005	336	.097	..	336	.100	..
168	.378	.010	168	.371	.011	168	.391	.013	448	.128	..	448	.137	+
224	.519	.020	224	.510	.020	224	.532	.023	560	.161	+	560	.172	.006
280	.662	.036	280	.647	.033	280	.681	.037	672	.198	.006	672	.208	.009
336	.809	.052	336	.789	.049	336	.831	.055	784	.232	.010	784	.244	.013
392	.974	.077	392	.941	.070	392	1.000	.079	896	.273	.016	886	.290	.019
448	1.142	.106	448	1.104	.093	448	1.174	.110	952	.293	..	952	.312	
476	1.230		504	1.276	.129	476	1.270		1008	.318	.022	1008	broke	
504	broke		532	1.377		504	broke		1064	.340				
			553	broke					1120	broke				
∴ Ultimate deflection = 1.312. Broke $\frac{1}{4}$ of an in. from the centre.			∴ Ultimate deflection = 1.440. Broke $\frac{3}{8}$ of an in. from the centre.			∴ Ultimate deflection = 1.356. Broke at the centre.			∴ Ultimate deflection = .362. Broke $\frac{1}{2}$ an inch from the centre.			∴ Ultimate deflection = .332. Broke $\frac{1}{4}$ of an in. from the centre.		

Carron No. 3, hot blast, is a harder iron, with less lustre than its predecessor the cold blast; it is also worked with greater difficulty, and produces a harsh, sonorous sound under the file. It is an iron well adapted for mixing, and of value in heavy castings when used in conjunction with some of the best Welsh irons.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking Weight (b).	Ultimate deflection (d).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	7056	17813700	507.0	1.307	662.6
Experiment 2nd, bar 4 ft. 6 in. between supports,	7056	17949900	538.3	1.448	779.5
Experiment 3rd, bar 4 ft. 6 in. between supports,	..	17855700	514.7	1.341	690.2
Mean,	7056	17873100	520.0	1.365	710.7
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	1113.3	.3627	403.8
Experiment 5th, bar 2 ft. 3 in. between supports,	..	..	1024.0	.3297	337.6
Mean,	..	..	1068.6	.3462	370.7

Comparative results of Carron Iron No. 3.

Distance between supports 4 ft. 6 in. and 2 ft. 3 in.

Strength of Cold Blast Iron.		Strength of Hot Blast Iron.		Ratio of Strengths.
446.3 436.2 450.2	444.2	507.0 538.3 514.7	520.0	1000 : 1170
854.5 937.9	896.2	1113.3 1024.0	1068.6	1000 : 1192
Mean ratio of strengths, 1000 : 1181				

Results of products, and ratio to resist impact.

Product of strength by ultimate deflection in Cold Blast Iron.		Product of strength by ultimate deflection in Hot Blast Iron.		Ratio of products, or of power to resist impact.
629.3 564.0 588.4	593.9	662.6 779.5 690.2	710.7	1000 : 1196
259.9 340.3	300.1	403.8 337.6	370.7	1000 : 1205
Mean ratio of power to sustain impact, 1000 : 1201				

TABLE IX.—Scotch Iron.—Muirkirk No. 1, Cold Blast.

Experiment 1. Depth of bar, 1.015 Breadth of do. 1.007 Distance between supports, 4 ft. 6 in.			Experiment 2. Depth of bar, 1.049 Breadth of do. 1.025 Distance between supports, 4 ft. 6 in.			Experiment 3. Depth of bar, 1.013 Breadth of do. 1.003 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.042 Breadth do. 1.025 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
28	.076	..	28	.067	..	112	.035	..	112	.035	..
56	.150	+	56	.133	+	224	.076	..	224	.070	..
112	.298	.013	112	.267	.010	336	.117	+	336	.112	+
168	.471	.030	168	.421	.027	448	.160	.007	448	.152	.007
224	.660	.053	224	.589	.049	560	.206	.010	560	.192	.011
280	.862	.085	280	.767	.077	672	.250	.018	952	.400	
336	1.096	.131	336	.961	.111	784	.309	.029	980	broke	
392	1.339	.186	392	1.177	.159	896	.377	.045			
448	1.650	.284	448	1.420	.227	952	.410				
476	broke		476	1.554		1008	broke				
			483	broke							
∴ Ultimate deflection=1.781. Broke at the centre.			∴ Ultimate deflection=1.583. Broke at the centre.			∴ Ultimate deflection =.440. Broke ½ an inch from the centre.			∴ Ultimate deflection=.412. Broke ⅜ of an inch from the centre.		

The Muirkirk No. 1, cold blast, is a remarkably fine, soft iron, with large, open and brilliant crystals, of a bluish gray colour; it presents great regularity in its crystaline structure, the crystals slightly diminishing in size as they recede from the centre. In its working properties, as well as in appearance, it is much akin to the Elsicar and Low Moor iron, and from its fluidity and strength may be safely used for every purpose of casting.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking weight (b).	Ultimate deflection (d).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	7050	14050600	458.8	1.808	829.5
Experiment 2nd, bar 4 ft. 6 in. between supports,	7177	13956500	428.2	1.660	710.8
Mean,	7113	14003550	443.5	1.734	770.1
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	979.3	.4457	436.5
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	880.6	.4293	378.0
Mean,	..	..	929.9	.4375	407.2

TABLE X.—Muirkirk No. 1 Pig Iron, Hot Blast.

Experiment 1. Depth of bar, 1.015 Breadth of do. 1.010 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long.			Experiment 2. Depth of bar, 1.025 Breadth of do. 1.035 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long.			Experiment 3. Depth of bar, 1.020 Breadth of do. 1.020 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.035 Breadth do. 1.029 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
28	.079	..	28	.069	..	112	.043	..	112	.037	..
56	.160	+	56	.144	+	224	.090	.005	224	.073	+
112	.326	.013	112	.287	.011	336	.138	.008	336	.112	.005
168	.507	.029	168	.445	.021	448	.185	.010	448	.152	.008
224	.700	.051	224	.610	.036	560	.231	.015	560	.190	.011
280	.909	.082	280	.780	.059	672	.289	.022	672	.230	.014
336	1.141	.129	336	.978	.090	784	.357	.039	784	.277	.020
392	1.428	.207	392	1.190	.135	812	broke		896	.328	.031
420	1.571		420	1.310					952	.354	
441	broke		448	broke					1008	broke	
∴ Ultimate deflection = 1.668. Broke $2\frac{3}{8}$ inch. from the centre.			∴ Ultimate deflection = 1.412. Broke $2\frac{3}{8}$ inch. from the centre.			∴ Ultimate deflection = .371. Broke $\frac{1}{4}$ an inch from the centre.			∴ Ultimate deflection = .378. Broke at the centre.		

This iron is inferior to the Muirkirk No. 1 cold blast; it is what is technically called *Kishie*, or full of a great variety of rich crystals sparkling in the midst of a duller and more compact mass; an appearance which is invariably present in irons of great fluidity and richness.

In the turning and filing process it is superior to the Carron No. 2 cold blast; and equal in every other respect, except strength, to any of the former irons we have experimented upon.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking weight (*b*).	Ultimate deflection in inches. (*d*).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	6948	12805700	423.8	1.693	717.5
Experiment 2nd, bar 4 ft. 6 in. between supports,	6959	13783100	412.0	1.447	596.1
Mean.	6953	13294400	417.9	1.570	656.8
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	765.2	.3784	289.5
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	914.5	.3912	357.8
Mean,	..	..	839.8	.3848	323.6

Comparative results of Muirkirk Iron No. 1.

Distance between supports, 4 ft. 6 in. and 2 ft. 3 in.

Strength of Cold Blast Iron.		Strength of Hot Blast Iron.		Ratio of strengths.
458.8 } Mean 428.2 } 443.5		423.8 } Mean 412.0 } 417.9		1000 : 942
979.3 } 880.6 } 929.9		765.2 } 914.5 } 839.8		1000 : 912
	Mean ratio of strengths,			1000 : 927

The products and ratio to resist impact.

Products of strength by ultimate deflection in Cold Blast Iron.		Products of strength by ultimate deflection in Hot Blast Iron.		Ratio of products, or of power to resist impact.
829.5 } 710.8 } 770.1		717.5 } 596.1 } 656.8		1000 : 852
436.5 } 378.0 } 407.2		289.5 } 357.8 } 323.6		1000 : 794
	Mean ratio of power to sustain impact,			1000 : 823

Modulus of elasticity in lbs. for a base of an inch square.

Cold Blast Iron,	14,050,600	Hot Blast Iron,	12,805,700
Ditto,	13,956,500	Ditto,	13,783,100
Mean,	14,003,550	Mean,	13,294,400

Effects of Time.

In former experiments on the transverse strength of cast-iron, it has been assumed that the elasticity remained perfect to the extent of one-third, at least, of the breaking weight. This assumption, which has been attempted to be proved by Tredgold, has gained considerable credence; but so far as I can perceive there appears to be no ground for such an opinion. In the earlier experiments on the subject of hot and cold blast irons, it was observed by Mr Hodgkinson that in some cases the elasticity was considerably injured with one-fifth or one-sixth of the breaking weight. This fact was of such importance as to induce me to pay considerable attention to the set in the preceding tables, and also to note the defects of elasticity in those that follow, up to the time of the weights becoming permanent upon the bars. From the methods thus adopted it will be seen that the value of the set has been given with the deflections at regular intervals of weights, from the commencement of the experiment to the time of fracture, and the connexion between the weights, deflections, and set, will therefore in all probability be better observed.

The early period at which the elasticity became injured caused, in addition to the above, an extended series of experiments, to determine whether such injury to the elasticity would not (with the weight continued) ultimately break the bar. This became a debatable, and very important, question between Mr. Hodgkinson and myself; the one contending for time, and the other for a permanent state of elasticity in the ratio of the loads and the forces respectively.

The inquiry therefore was, to what extent can cast-iron be loaded, or how much would it permanently bear without endangering its security? This was in reality a question of great interest, one which involved important considerations, such as the stability of bridges, warehouses, factories, and many other erections to which cast-iron is applied, and which depends almost entirely upon our knowledge of its ductility and strength.

It assuredly must be of importance to know that a material of such value, and so extensively used in almost every branch of art, can be trusted, and that we may with safety depend upon its security throughout the endless variety of forms and strains to which it is subjected.

Cast-iron has hitherto been considered a brittle, and, by many persons, an insecure material; yet, notwithstanding the distrust and suspicion with which it was viewed, it still continues to increase in demand, and that to a great extent, in most countries where the arts are cultivated. Every inquiry therefore which tends to exhibit its peculiar properties as respects strength, ductility, &c., must be regarded as an additional step towards a greater degree of security in its application. Under these impressions the following experiments were instituted.

Five bars of cold, and five of hot blast, Coed-Talon No. 2 iron, cast to be one inch square, were selected, and having loaded them with different weights, with their ends supported on props 4 feet 6 inches asunder, they were left in this position, to determine how long they would sustain the loads without breaking.

It is now upwards of 15 months since the bars were charged, and if we are to judge from the hardihood displayed in their resistance to the load, there is every chance of a long and protracted experiment. In fact, there is every probability of the experiments outliving the experimenter.

TABLE XI.

Table of deflections as exhibited with permanent weights of 280 lbs. suspended from the centre of bars of cold and of hot blast Coed-Talon iron, cast to be one inch square, and left to determine the effect produced on each bar after given intervals of time.

Distance between supports 4 feet 6 inches.

Experiment 1. Cold blast iron No. 2. Depth of bar, 1.050 Breadth of do. 1.030					Experiment 2. Hot blast iron No. 2. Depth of bar, 1.050 Breadth of do. 1.010			
Weight in lbs.	Observed deflection in inches.	Deflection, load removed.	Date of observation. 1837	Temperature at the time of observation.	Weight in lbs.	Observed deflection in inches.	Deflection, load removed.	
56	.144	..			56	.153	..	
112	.309	.020			112	.337	.022	
168	.499	..			168	.548	..	
224	.708	.075			224	.784	.088	
280	.916	.108	March 9th	49°	280	1.043	.132	The permanent weight, 280lbs. was fixed stationary upon the cold blast bar at 6 o'clock p.m., March 8th 1837, and an equal weight was left to remain upon the hot blast bar on the following day at 10 a.m.
280	.930		Do. 11th	..	280	1.064		
280	.932		Do. 17th	..	280	1.067		
280	.930		April 15th	47	280	1.078		
280	.932		May 31st	62	280	1.082		
280	.937		Aug. 22nd	70	280	1.086		
280	.942		Nov. 18th	45	280	1.083		
280	.941		Jan. 8, 1838	38	280	1.086		
280	.945		March 12th	51	280	1.091		
280	.963		June 23rd	78	280	1.107		From observations taken this day, June 23rd,

the mean deflection for 15 months was found to be, for cold blast .936, increase .004, for hot blast, 1.079, increase .012.

Results in the preceding Table, showing the progressive and increased ratio of deflections from March 11th, 1837, to June 23rd, 1838.

Cold Blast Iron, deflection in inches.	Date of observation	Temp.	Hot Blast Iron, deflection in inches.	Ratio of increase of deflections.
1.684	March 11th, 1837.	..	1.064	..
1.824	June 23rd. 1838.	78°	1.107	..
.033	Increase.	..	.043	1000 : 1303

From the above it appears, that a progressive increase, in the deflections of the bars, has taken place, since the time they were charged, in the ratio of 1000, for the cold blast, to 1303, for the hot blast.

The hot blast bar in these experiments being more deflected than the cold blast, indicates that the particles are more extended and compressed in the former iron, with the same weights, than in the latter. This excess of deflection may in some degree account for the rapidity of increase, which it will be observed is considerably greater in the hot than in the cold blast bar.

The next experiment was from the same metal, cast as before into rectangular bars 1 inch square, and loaded with additional weights, amounting to 336 lbs. on each bar.

Table XII.

Table of deflections as exhibited with permanent weights of 336 lbs. suspended from the centre of bars of cold and of hot blast Coed-Talon iron, cast to be one inch square, and left to determine the effect produced on each bar after given intervals of time.

Distance between supports 4 ft. 6 in.

Experiment 1. Cold blast iron No. 2. Depth of bar, 1.020 Breadth of do. 1.030			Date of Observation. 1837&1838.	Temperature at the time of observation.	Experiment 2. Cold blast iron No. 2. Depth of bar, 1.040 Breadth of do. 1.020			
Weight in lbs.	Observed deflection in inches.	Deflection, load removed.			Weight in lbs	Observed deflection in inches.	Deflection, load removed.	
56	.148	..			56	.160	..	The weight, 336 lbs.,
112	.318	.028			112	.346	.026	was left permanent on
168	.515	..			168	.567	..	the cold blast bar on
224	.732	.086			224	.809	.092	Friday, March 3rd, at 6
280	.961	..			280	1.077	..	o'clock p.m. The same
336	1.221	.192			336	1.374	.212	weight (336 lbs.) was
			1837					fixed stationary upon
336	1.267		March 6th		336	..		the hot blast bar on
336	1.270		Do. 9th	49°	336	1.454		Tuesday, March 7th, at
336	1.270		Do. 11th	49	336	1.461		11 o'clock, a.m.
336	1.271		Do. 17th	49	336	1.462		When the weights,
336	1.271		April 15th	47	336	1.475		336 lbs., were placed on
336	1.274		May 31st	62	336	1.481		the cold blast bar, after
336	1.288		Aug. 22nd	70	336	1.504		the elasticity had been
336	1.286		Nov. 18th	45	336	1.499		taken, the deflection in-
			1838					creased from 1.221 to
336	1.288		Jan. 8th	38	336	1.502		1.267.
336	1.298		March 12th	51	336	1.505		On the hot blast bar
336	1.316		June 23rd	78	336	1.538		the deflection increased

with the restoration of the weights from 1.374 to 1.397. The mean deflection under various temperatures is, for the cold blast 1.280, increase .009; for the hot blast 1.486 increase .024.

Results in the preceding Table, showing the progressive and increased ratio of deflections from the 11th of March, 1837, to 23rd of June, 1838.

Cold Blast Iron, deflection in inches.	Date of observation	Temp.	Hot Blast Iron, deflection in inches.	Ratio of increase of deflections.
1.270	March 11th, 1837	..	1.461	
1.316	June 3rd, 1838	78°	1.538	
.046	Increase.	..	.077	1000 : 1673

The ratio of increase is here much greater than what is indicated by the lesser weights—280 lbs.—in Table, No. XI. The progression towards fracture (providing we assume a progressive yielding in that direction) is advancing at a quicker rate in this case than with the lighter loads; consequently the resisting powers are becoming gradually weaker. We must, however, observe that the temperature of the air in the room where the bars are placed was at 78° when the last observations were made, whereas the temperature

was only 46° at the time the bars were first loaded. This difference in the temperature will give rather greater deflections, from the expansion produced on the bars in a medium of 78°. In confirmation of this opinion I would beg to refer to the observations of November 18th when the atmosphere of the room was at 45°; the deflections had then decreased from 1.288 to 1.286 in the cold blast iron; and from 1.504 to 1.499 in the hot blast iron.

TABLE XIII.

Table of deflections as exhibited with permanent weights of 392 lbs. suspended from the centre of bars of cold and of hot blast Coed-Talon Iron, cast to be one inch square and left to determine the effect produced on each bar after given intervals of time.

Distance between supports 4 ft. 6 in.

Experiment 1. Cold Blast Iron No. 2 Depth of bar, 1.030 Breadth do. 1.020					Experiment 2. Hot Blast Iron No. 2 Depth of bar, 1.050 Breadth do. 1.000			
Weight in lbs.	Observed deflection in inches.	Deflection, load removed.	Date of Observation. 1837&1838.	Temperature at the time of observation.	Weight in lbs.	Observed deflection in inches.	Deflection, load removed.	
56	.153	.003			56	.150	..	The weight, 392 lbs., was fixed stationary on the cold blast bar, on Friday, March 3rd, at 12 o'clock, and the same weight was placed upon the hot blast bar at 11 o'clock, a.m., on the following day. On re-instating the weight after the deflection and defects of elasticity had been taken, the deflection had increased in the cold blast from 1.616 to 1.636, and from 1.635 to 1.661 in the hot blast. Mean deflection thro'-out all the changes of temperature in 15 months.—For the cold blast 1.742, increase .048; hot blast 1.777, increase .014.
112	.334	.022			112	.333	.023	
168	.541	..			168	.551	..	
224	.769	.089			224	.775	.086	
280	1.013	..			280	1.029	..	
336	1.294	.199			336	1.311	.188	
392	1.616	.292			392	1.635	.272	
392	1.684		March 6th		392	1.715		
392	1.694		Do. 9th	49°	392	1.758		
392	1.694		Do. 11th		392	1.760		
392	1.694		Do. 17th		392	1.763		
392	1.716		April 15th	47	392	1.767		
392	1.725		May 31st	62	392	1.775		
392	1.737		Aug. 2nd	70	392	1.783		
392	1.724		Nov. 18th 1838	45	392	1.773		
392	1.722		Jan. 8th	38	392	1.773		
392	1.801		March 12th	51	392	1.784		
392	1.824		June 23rd.	78	392	1.803		

Results in the preceding Table, showing the progressive and increased ratio of deflections from March 11th, 1837, to June 23rd, 1838.

Cold Blast Iron, deflection in inches.	Date of observation	Temp.	Hot Blast Iron, deflection in inches.	Ratio of increase of deflections.
1.684	March 6th, 1837.	..	1.715	..
1.824	June 23rd, 1838.	78°	1.803	..
.140	Increase.	..	.088	1000 : 628

On comparing the above with Table No. XII, preceding it, there will be found a greater proportionate deflection in both the cold and hot blast bars than is observable with the lighter weights of 336 lbs., and in both instances

the deflection is greater in the hot than in the cold blast. The same is the case in experiment 2nd of the next Table, where the deflection indicated by 348 lbs. is less than what is exhibited on the hot blast with 336 lbs., being as 1.437 to 1.803. This may be accounted for by the bars which were newly cast containing, in all probability, a greater proportion of carbon, and consequently having more ductility than those in Tables No. XII and No. XIV.

The ratio of increase in the deflections is much higher in the cold blast iron than the hot; and notwithstanding the silent and apparently progressive approach towards rupture, there is every appearance of a long and tedious experiment. It cannot however be doubted that fracture will sooner take place in the cold than in the hot blast, as the former is advancing to that point with greater rapidity, or in the ratio of 1000 to 628. We may therefore expect the bar from the cold blast iron to be the first to give way, and probably about the time when the deflection verges on two inches.

Table XIV.

Table of deflections as exhibited with permanent weights of 448 lbs. suspended from the centre of bars of cold and hot blast Coed-Talon iron, cast to be one inch square, and left to determine the effect produced on each bar after given intervals of time.

Distance between supports 4 ft. 6 in.

Experiment 1. Cold Blast Iron No. 2. Depth bar, 1.000 Breadth 1.010			Experiment 2. Cold Blast Iron No. 2. Depth bar, 1.020 Breadth 1.030			Date of Observation.	Temperature.	Experiment 3. Hot Blast Iron No. 2. Depth bar, 1.040 Breadth 1.010			Remarks.
Weight in lbs.	Observed deflection in inches.	Deflection, load removed.	Weight in lbs.	Observed deflection in inches.	Deflection, load removed.	1837 & 1838.		Weight in lbs.	Observed deflection in inches.	Deflection, load removed.	
56	.155	..	56	.129	..			56	.165	..	The permanent weights, 448 lbs., were placed, in ex. 1, upon the cold blast bar on Saturday, the 4th March, at 4 o'clock p.m., 1837, and the same weights became stationary on the cold blast bar, in ex. 2, on the previous day, at 4 o'clock p.m.
112	.333	.021	112	.264	.009			112	.360	.025	
168	.536	..	168	.416	..			168	.579	..	
224	.755	.076	224	.578	.039			224	.829	.086	
280	.992	..	280	.754	..			280	..	..	
336	1.262	.167	336	.934	.087			336	1.419	.208	
392	1.556	..	392	1.131	..			392	broke with this weight.		
448	1.904	..	448	1.361	.192						
						1837.					
448	1.964	.404	448	1.410		March 6					
448	2.005		448	1.413		Do. 9	49°				
448	2.005		448	1.413		Do. 11					
448	2.010		448	1.413		Do. 17					
448	2.014	broke after sustaining the load 37 days. The deflection increased from 1.904 to 1.964 after the defects of elasticity were last taken.									In ex. 3, 392 lbs. broke the bar; several other bars of hot blast were tried, but they successively broke on lying on the weights, 448 lbs. Mean deflection for 15 months, ending 23rd June, was for cold blast 1.431, increase 0.28.
			448	1.422		April 15	47				
			448	1.424		May 31	62				
			448	1.438		Aug. 22	70				
			448	1.451		Nov. 18	45				
						1838.					
			448	1 430		Jan. 8	38				
			448	1.429		March 12	51				
			448	1.457		June 23	78				

Results in the preceding Table, showing the progressive and increased ratio of deflections from March 6th, 1837, to June 23rd, 1838.

Cold Blast Iron, deflection in inches.	Date of observation	Temp.	Hot Blast Iron, deflection in inches.	Ratio of increase of deflections.
Experiment 3.				
1.410	March 6th, 1837.	..		
1.457	June 23rd, 1838.	70°		
.047	Increase.	..		

The greater degree of weakness here exhibited in the hot blast iron than the cold renders our comparative experiments in this Table defective; several bars were tried in succession, but they separately gave way, some on laying on the load, 448 lbs., and others after supporting it for a few seconds.

In experiment 1st, Table XIV., it will be noticed that a bar from the cold blast iron, after being charged with the full load, 448 lbs., continued to support it for a period of 37 days; this was not, however, accomplished without signs of weakness, as will be seen from the progressive increase which took place in the deflections from the 6th to the 17th of March; and also from observed discrepancies some time previous to its rupture. In making these statements it must be observed, that the bar in experiment 1st was thinner than any of the others, and had borne for thirty-seven days a weight greater than had broken bars of the same size in previous experiments upon the Coed-Talon iron, when the weights were laid on without loss of time.

Abstract of comparative increase and ratio of deflections on the whole bars from March 6th, 1837, to June 23rd, 1838.

	Cold Blast Iron, increase of deflection in inches.	Hot Blast Iron, increase of deflection in inches.	Ratio of deflections.
Increase of deflection, Table XI.	.033	.043	..
Increase of deflection, Table XII.	.046	.077	..
Increase of deflection, Table XIII.	.140	.088	..
Increase of deflection, Table XIV.	.047	..	..
Mean,	.066	.069	1000 : 1045

The mean increase of deflections on the whole bars is therefore .066 for the cold blast, and .069 for the hot blast, being in the ratio of 1000 to 1045.

The interest which experiments of this kind may be expected to excite, and the nature as well as the value of the material on which they are here made, will, it is hoped, prove an inducement for extended investigation on this subject.

[TO BE CONTINUED.]

Manufacture of Lead Pencils.

The best black-lead pencils of this country are formed of slender parallelopipeds, cut out by a saw from sound pieces of plumbago, which have been previously calcined in close vessels at a bright red heat. These parallelopipeds are generally enclosed in cases made of cedar wood, though of late years they are also used alone, in peculiar pencil cases, under the name of ever-pointed pencils, provided with an iron wire and screw, to pro-

trude a minute portion of the plumbago beyond the tubular metallic case, in proportion as it is wanted.

In the year 1795, M. Conté, a French gentleman, well acquainted with the mechanical arts, invented an ingenious process for making artificial black-lead pencils of superior quality, by which he and his successor and son-in-law, M. Humblot, have realized large fortunes.

Pure clay or clay containing the smallest proportion of calcareous or siliceous matter, is the substance which he employed to give aggregation and solidity, not only to plumbago dust, but to all sorts of coloured powders. That earth has the property of diminishing in bulk, and increasing in hardness, in exact proportion to the degree of heat it is exposed to, and hence may be made to give every degree of solidity to crayons. The clay is prepared by diffusing it in large tubs through clear river water, and letting the thin mixture settle for two minutes. The supernatent, milky liquor is drawn off by a syphon from near the surface, so that only the finest particles of clay are transferred into the second tub, upon a lower level. The sediment which falls very slowly in this tub, is extremely soft and plastic. The clear water being run off, the deposit is placed upon a linen filter, and allowed to dry. It is now ready for use.

The plumbago must be reduced to a fine powder in an iron mortar, then put into a crucible, and calcined at a heat approaching to whiteness. The action of the fire gives it a brilliancy and softness which it would not otherwise possess, and prevents it from being affected by the clay, which it is apt to be in its natural state. The less clay there is mixed with the plumbago, and the less the mixture is calcined, the softer are the pencils made of it; the more clay used the harder are the pencils. Some of the best pencils made by M. Conté, were formed of two parts of plumbago and three parts of clay; others of equal parts. This composition admits of indefinite variations, both as to the shade and hardness; advantages not possessed by the native mineral. While the traces may be made as black as those of pure plumbago, they have not that glistening aspect which often impairs the beauty of black-lead drawings. The same lustre may, however, be obtained by increasing the proportion of powdered plumbago relatively to the clay.

The materials having been carefully sifted, a little of the clay is to be mixed with the plumbago, and the mixture is to be triturated with water into a perfectly uniform paste. A portion of this paste may be tested by calcination. If, on cutting the indurated mass, particles of plumbago appear, the whole must be further levigated. The remainder of the clay is now to be introduced, and the paste is to be ground with a muller upon a porphyry slab, till it be quite homogeneous, and of the consistence of thin dough. It is now to be made into a ball, put upon a support, and placed under a bell glass inverted in a basin of water, so as to be exposed merely to the moist air.

Small grooves are to be made in a smooth board, similar to the pencil parallelopipeds, but a little longer and wider, to allow for the contraction of volume. The wood must be boiled in grease, to prevent the paste from sticking to it. The above described paste being pressed with a spatula into these grooves, another board, also boiled in grease, is to be laid over them very closely, and secured by means of screw-clamps. As the atmospheric air can get access only to the ends of the grooves, the ends of the pencil pieces become dry first, and by their contraction in volume get loose in the grooves, allowing the air to insinuate further and to dry the remainder of the paste in succession. When the whole piece is dried, it be-

comes loose, and might be turned out of the grooves. But before this is done, the mould must be put into an oven moderately heated, in order to render the pencil pieces still drier. The mould should now be taken out, and emptied upon a table covered with cloth. The greater part of the pieces will be entire, and only a few will have been broken, if the above precautions have been duly observed. They are all, however, perfectly straight, which is a matter of the first importance.

In order to give solidity to these pencils, they must be set upright in a crucible till it is filled with them, and then surrounded with charcoal powder, fine sand, or sifted wood ashes. The crucible, after having a luted cover applied, is to be put into a furnace, and exposed to a degree of heat regulated by the pyrometer of Wedgewood; which degree is proportional to the intended hardness of the pencils. When they have been thus baked, the crucible is to be removed from the fire, and allowed to cool with the pencils in it.

Should the pencils be intended for drawing architectural plans, or for very fine lines, they must be immersed in melted wax, or suet, nearly boiling hot, before they are put into the cedar cases. This immersion is best done by heating the pencils first upon a gridiron, and then plunging them into the melted wax or tallow. They acquire by this means a certain degree of softness, are less apt to be abraded by use, and preserve their points much better.

When these pencils are intended to draw ornamental subjects with much shading, they should not be dipped as above.

Second process for making artificial pencils, somewhat different from the preceding.—All the operations are the same, except that some lamp-black is introduced along with the plumbago powder and the clay. In calcining these pencils in the crucible, the contact of air must be carefully excluded, to prevent the lamp-black from being burned away on the surface. An indefinite variety of pencils, of every possible black tint, may thus be produced, admirably adapted to draw from nature.

Another ingenious form of mould is the following:

Models of the pencil-pieces must be made in iron, and stuck upright upon an iron tray, having edges raised as high as the intended length of the pencils. A metallic alloy is made of tin, lead, bismuth and antimony, which melts at a moderate heat. This is poured into the sheet-iron tray, and after it is cooled and concreted, it is inverted, and shaken off from the model bars, so as to form a mass of metal perforated throughout with tubular cavities, corresponding to the intended pencil-pieces. The paste is introduced by pressure into these cavities, and set aside to dry slowly. When nearly dry, the pieces get so much shrunk that they may be readily turned out of the moulds upon a cloth table. They are then to be completely desiccated in the shade, afterwards in a stove-room, next in the oven, and lastly ignited in the crucible, with the precautions above described.

M. Conté recommends the hardest pencils of the architect to be made of lead melted with some antimony and a little quicksilver.

In their further researches upon this subject, M. Conté and M. Humblot found that the different degrees of hardness of crayons could not be obtained in a uniform manner by the mere mixture of plumbago and clay in determinate doses. But they discovered a remedy for this defect in the use of saline solutions, more or less concentrated, into which they plunged the pencils, in order to modify their hardness, and increase the uniformity of their texture. The non-deliquescent sulphates were preferred for this pur-

pose: such as sulphate of soda, &c. Even sirop was found useful in this way.—*Dr. Ure's Dict.* Mech. Mag.

Description of a Voltaic Battery. By S. E. Hoskins, *M. D. Communicated in a letter to the Editor.*

Sir,—The plate voltaic battery, although nearly superseded by the more modern cylindrical arrangements, is still of sufficient value to sanction an endeavour towards improving its construction.

If the following description of a method I have devised for its simplification be worthy of a place in your excellent Annals, I shall be obliged by its insertion.

The various inconveniences arising from the usual methods of connecting galvanic plates, and the difficulty of cleansing the zincs when soldered to the coppers, induced me some time ago to seek a more simple mode of effecting junction. The result is a method whereby solder, mercury cups, and binding screws are dispensed with; and perfect connexion between a dozen or eighteen pair of plates effected by the mere adjustment of a couple of thumb screws.

Fig. 1.

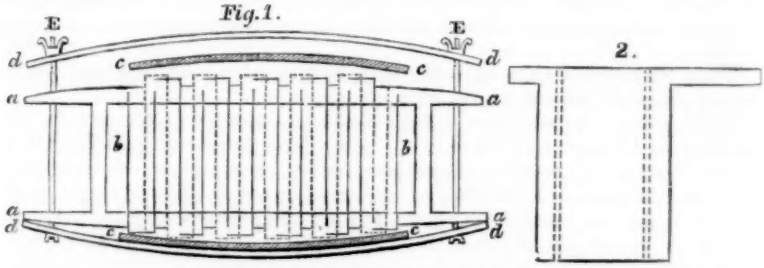

Fig. 1, represents a wooden frame with fine transverse saw cuts, half an inch deep, and one fourth or one sixth of an inch apart. This frame is intended to fit over a trough without partitions. Each of its projecting extremities is perforated for the passage of a brass bolt, having a head at one end and a deep thread for the reception of a thumb screw at the other.

The plates which are dropped into the transverse saw cuts of the frame, alternately interlacing, according to Messrs. De la Rue and Young's plan, are cut out of copper and thin sheet zinc.*

The plates being dropped into the frame, the long ears are to be bent over its convex sides, so that a zinc shall be in contact with a copper plate. This being done, a strip of wood is placed over the bent ears: over this is a strip of brass, and the whole bound together by the bolts and thumb screw, until perfect contact is secured.

This arrangement will be better understood by reference to fig. 1, which gives a transverse view of the apparatus.

a, *a*, *a*, *a*, are the plano-convex sides of the frame. *b*, *b*, *b*, *b*, the alternating plates of zinc and copper. *c*, *c*, *c*, *c*, thin strips of white deal, varnished, and barely long enough to cover the series of overlapping ears. *d*, *d*, *d*, *d*, strips of thick sheet brass, as long as the sides of the frame, and perforated

*The thinner the better, as it can be readily cut and bent, and does not require wide saw cuts, which would weaken the frame;—lasts quite long enough for one durable operation, and admits of fresh plates being used each time.

at each extremity. E, E, bolts and thumb screws, which are represented as having tightened the binders on one side, and in readiness to do so on the other.

The dotted lines, in fig. 2, are intended for pieces of varnished cord permanently fixed on the copper plates: a simple but effectual method of keeping the plates asunder.

The battery may be used with dilute acid, or with the acidulated solution of sulphate of copper, recommended by M. De la Rue. With the latter, good decomposing action will continue for upwards of an hour; at the end of which time three inches of fine platinum wire can be kept in a state of incandescence for half an hour, or more. In short, the power of the battery is quite equal to that of other plate arrangements possessing advantages peculiar to itself. These advantages are convenience in an extended sense of the word, and economy both of time and money. Eighteen or twenty pair of plates may be sundered and put together again in a few minutes; the zincs therefore may be washed, amalgamated, or replaced, with great facility and without the use of the soldering tool, the waste of mercury, or the annoyance arising from a series of binding screws. A stock fashioned by the manipulator may always be kept at hand with no more expense than that of the material; and he may extend his series with ease to any extent.

The only parts which cannot in general be made by the amateur are the trough, the screws, and the frame. The latter requires some degree of nicety in its construction,—none however which a common carpenter, properly directed, may not attain.

A small battery, such as I have described, has been deposited at the Polytechnic Institution, ever since the month of October. Mr. Bachhoffner, to whose kindness on all occasions I am much indebted, has performed a series of carefully conducted experiments with it, and allows me to state in his name that my battery is much more powerful than others of the same order, owing to the approximation of the plates, and that it is much more convenient and manageable than any.

Sturgeon's Annals of Elec.

'*Experimental Researches upon the Cost of the Light afforded by different Lamps and Candles*,' *by Andrew Ure, M. D., F. R. S., &c.*

The author having instituted a series of experiments to determine the advantages of Mr. Parker's new hot oil lamp, adopts as the standard of comparison the French mechanical lamp, in which the oil is raised by machinery, so as continually to overflow at the bottom of the burning wick. The relative illumination was determined by the well-known method of the equal intensity of shadows, and verified by that adopted by Professor Wheatstone, namely, by the relative brightness of the opposite sides of a revolving ball. The chimney of the new lamp differs from the chimneys of other lamps in having a bell-mouthed glass chimney, and above it a chimney of iron, with a parted diaphragm for the purpose of causing a certain portion of the heat of the flame to reverberate against the interior cylindric cavity of the oil cistern. The bell mouth is formed in a mould, and is far better suited for producing a steady flame than the rectangularly contracted chimney of the mechanical lamp. The intensity of the shadows from the mechanical lamp and hot oil lamp of a wire a few inches long, and of the thickness of a crow-quill, was equal, at a distance of 10 and 11 feet respectively; their relative illuminations being as the squares of these, are, 100 and 121 respectively, and the consumption of the best sperm oil was 15.2 and 11.6 grains per minute;

the relative cost of illumination for this oil would then appear to be 50 per cent. in favour of the new lamp. On trying Southern whale oil, the cost of illumination appeared to be about one-third that of the mechanical, and one-half that of the hot oil lamp with sperm oil. The author tried many other substances, and, comparing the various illuminations, concludes that the hot oil lamp with Southern whale oil affords an economy of light nearly 12 times greater than stearine or German wax candles, $7\frac{1}{2}$ times greater than tallow mould, 11 times greater than cocoa nut, $8\frac{1}{4}$ times greater than Palmer's, $17\frac{1}{3}$ times greater than spermaceti, and 18 times greater than wax candles. The author had also compared the illumination produced by one of the Fresnel's Lamps deposited at the Trinity House. This lamp consists of four concentric, circular wicks, placed in a horizontal plane, the innermost being $\frac{7}{8}$ths of an inch, and the outermost $3\frac{1}{2}$ inches in diameter. The intensity of the shadows from this and from the mechanical lamp were equal at a distance of 13 feet 3 inches, and 4 feet 6 inches respectively; taking the squares of these, the Fresnel lamp gives about nine times the light of the mechanical, which latter may be assumed as equal to that of eleven average wax candles. On comparing one of the best Argand-lamps with the mechanical, the former was to the latter as 10 to 11; so that the illumination of the Fresnel lamp, instead of being, as has been asserted, equal to 40 Argand lamps, is not equal to more than 9.6 of those lamps. In the Bude light, a small stream of oxygen is sent up through a small tube within a burning wick, which is $\frac{3}{8}$ths of an inch in diameter, and the flame of about $\frac{3}{4}$ths of an inch. The illuminating power is equal to about 30 wax candles. Dr. Ure also examined the illuminating power of different kinds of wax candles, and found that the light from a long-three and a short-three was the same, or $\frac{1}{11}$th of the mechanical lamp; also the light emitted from one of the six-to-the-pound was very little less, being $\frac{1}{12}$th of that of the mechanical lamp. The consumption of wax in a long or short-three may be taken at 126 grains per hour, and in a short-six at 125 grains per hour. Wax contains 81.75 parts of carbon in every 100 parts, and the combustion of these 100 parts produces 36 parts of carbonic acid; consequently, a wax candle will generate per hour about 375 grains of carbonic acid, or 800 cubic inches of gas. Now an average sized man developes and exhales from his lungs 1632 cubic inches of gas per hour; thus the combustion of two ordinary wax lights injure the air to about the same extent as the breathing of one man.

Athenæum.

On the injurious Effects of Kyan's Anti-Dry-Rot Solution, as regards the Destruction of vegetable Life in the Gardens at Thoresby, Nottinghamshire. Communicated by the Right Hon. the Earl of Manvers.

Some of the rafters in one of the pine and grape houses in Thoresby Park, having become quite decayed by dry rot, Earl Manvers was recommended to use timber for the new rafters which had been steeped in one of Kyan's patent tanks. Accordingly, ten new rafters for the roof lights to work upon were put up in February, 1837; such rafters being first steeped in the solution, at the strength of one pound of corrosive sublimate to ten gallons of water. These rafters were in use one year before being painted, and in that time totally killed three fine vines trained to the first three rafters, and seriously injured those trained to the remaining seven rafters; so much so, indeed, as to quite kill the fruit upon them; and, in fact, such was the injurious effect of the poisonous vapour drawn from the wood, that the fruit in

the remainder of the house was of a very inferior description. The pine plants standing immediately under these rafters were seriously injured, and a considerable number of them were quite destroyed; the remainder, on being placed in the fruiting pit, in a very short time put up a small weak premature fruit.

The cause of this great damage to both the vines and pine plants, was the damp vapour which arose from the heat of the house; and also from rain soakage occasionally falling upon them.

In the spring of 1838, these rafters were carefully painted four times over; but, although the injurious effects were thereby in some degree diminished, yet the plants looked unhealthy, and did not fruit properly.

At the present time, the young vines are looking yellow, and have not a single bunch of grapes upon them; and the pines under these ten rafters are weak and unhealthy, when compared with those at the other end of the house.

In 1837, twelve young vines in pots were watered with water taken from a tank in part supplied from the roof of this hot-house, and these plants were all killed in a very short time.

A trellis-work flower stand, made of deal timber that had been steeped in the solution, was placed in a small green-house in the gardens, and if this had not been taken out, every plant in the house would have been killed by the noxious vapour arising from the wood. The plants soon came round again after the removal of the trellis.* Gardener's Magazine.

Galvanic Decomposition.

Mr. Spencer detailed the following experiment. He took a piece of sulphuret of copper, and placed it in a narrow glass vessel half filled with sulphate of copper in solution, and immersed the sulphuret about half its length in this solution. He then added common salt, taking care that it should not intermingle with the cupreous solution underneath. He then placed it in the dark, and left it for a week. At the end of that time he examined it, and had the satisfaction of observing that several portions of it had become covered with very minute crystals of the pure metal. At the end of a fortnight still more beautiful crystals had been deposited. This experiment, Mr. Spencer stated, was made for the purpose of corroborating the experiment of Mr. Fox, in which that gentleman took a small portion of sulphuret of copper, to which he attached a piece of copper wire, and at the other end a portion of zinc; the arrangement was separated by a wall of clay, with sulphate of copper in solution in one cell, and a saline solution in the other. Mr. Spencer conceived, that by his arrangement the objection to Mr. Fox's experiment was overcome, viz. that it was always necessary to suppose the presence of two metals. Athenæum.

Drainage of Lands by Steam Power.

The drainage of land by steam power has been extensively adopted in

*Of the conservative efficacy of the Kyan Solution upon the woody fibre which has imbibed it, several articles in our pages afford satisfactory evidence;—of the remarkably deleterious nature of the effluvium from the surface of timber, thus treated, upon vegetable life, the above paper furnishes an instance singularly striking and demonstrative G.

the fens of Lincolnshire, Cambridgeshire, and Bedfordshire, and with immense advantage. A steam engine of ten horse power has been found to be sufficient to drain a district comprising 1000 acres of land, and the water can always be kept down to any given distance below the plants. If rain fall in excess, the water is thrown off by the engine; if the weather is dry, the sluices can be opened and the water let in from the river. The engines are required to work four months in the twelve, at intervals varying with the season, where the districts are large; the expense of drainage by steam power is about 2*s.* 6*d.* per acre. The first cost of the works varies with the different nature of the substrata, but generally it amounts to 1*l.* per acre for the machinery and buildings. An engine of forty horse power, with scoop wheels for draining, and requisite buildings, costs about 4000*l.*, and is capable of draining 4000 acres of land. In many places in the fens, land has been purchased at from 11*l.* to 20*l.* per acre, which has been so much improved by drainage, as to be worth from 60*l.* to 70*l.* per acre.—*Durham Advertiser.*

Mining Review.

Progress of Physical Science.

Establishment of Magnetic Observatories, and Naval Expedition for Magnetic Purposes.

We are glad to learn, that the following interesting Report (which is unfortunately without a date) has produced its desired effect upon her Majesty's Ministers, who have appointed three officers of Artillery, with adequate attendants, to go respectively to Montreal, to the Cape of Good Hope, and to St. Helena, to make the experiments on the variations, and dip of the needle, and the intensity of magnetism, frequently and simultaneously each day, for three years; Capt. Ross (the nephew of Sir J. Ross) is also appointed to go out in a ship for the same period, and make similar experiments and observations at various places specified by the Committee of the Royal Society. We shall rejoice if the results are as curious and valuable as the scientific projectors anticipate.

Report of a Joint Committee of Physics and Meteorology referred to, by the Council of the Royal Society, for an opinion on the propriety of recommending the establishment of fixed magnetic observatories, and the equipment of a naval expedition for magnetic observations in the Antarctic Seas, to Her Majesty's Government, and to report generally on the subject: together with the Resolutions adopted on that Report, by the Council of the Royal Society.

Report.

The subject of terrestrial magnetism has recently received some very important accessions which have materially affected, not only the point of view in which henceforward it will be theoretically contemplated, but also the modes of observation which will require to be adopted for completing our knowledge of the actual state of the magnetic phenomena, and furnishing accurate data for the construction and verification of theoretical systems. It was for a long time supposed that the changes in the position assumed by the needle at any particular point on the earth's surface might be conceived

as resulting from regular laws of periodicity, having for their arguments, 1st, a great magnetic cycle of several centuries, depending on unknown, and perhaps internal, movements or relations; and 2ndly, on the periodic alternations of heat and cold, depending on the annual and diurnal movements of the sun. The discovery of the affection of the needle by the aurora borealis, and of the existence of minute and irregular movements, which might be referred either to unperceived auroras or to other local and temporary causes, sufficed to show that the laws of terrestrial magnetism are not so simple as to admit of this summary form of expression; and the important discovery, first announced, we believe, by Baron Von Humboldt, that those temporary changes take place simultaneously at great distances in point of locality, a discovery which has since been remarkably confirmed and extended to very great intervals of distance, so as to include the whole extent of the European continent, by Gauss and Weber, and their coadjutors of the German Magnetic Association, has sufficed to show that the gist of the inquiry lies deeper, and depends upon relations far more complex, while at the same time the dominion of what might previously have been regarded as local agency, would require, in the new views consequent on the establishment of these facts, to be extended far beyond what ordinary usage would authorize as a just application of that epithet.

For a long time in the history of terrestrial magnetism, the variation alone was attended to. The consideration of the dip was then superadded; but the observation of this element being more difficult and delicate, our knowledge of the actual and past state of the dip over the earth's surface is lamentably deficient. It has lately appeared, however, that this element can be observed with considerable approximation, though not with nicety, at sea, so that no reason subsists why materials for a chart of the dip analogous to that of variation should not be systematically collected. Lastly, the intensity has come to be added to the list of observanda; and from the great facility and exactness with which it can be determined, this branch of magnetic knowledge has in fact made most rapid progress.

These three elements, the Horizontal Direction, the Dip, and the Intensity, require to be precisely ascertained before the magnetic state of any given station on the globe can be said to be fully determined. Nor can either of them, theoretically speaking, be said to be more important than the others, though the direction, on account of its immediate use to navigators, has hitherto had the greatest stress laid upon it, and been reduced into elaborate charts. A chart of the lines of total intensity has been recently constructed by Major Sabine.

All these elements are, at each point, now ascertained to be in a constant state of fluctuation, and affected by those transient and irregular changes which are above alluded to; and the investigation of the laws, extent, and mutual relations of these changes is now become essential to the successful prosecution of magnetic discovery, for the following reasons.

1st. That the progressive and periodical, being mixed up with the transitory changes, it is impossible to separate them so as to obtain a correct knowledge and analysis of the former, without taking express account of and eliminating the latter, any more than it would be practicable to obtain measures of the sea-level available for an inquiry into the tides, without destroying the irregular fluctuation produced by waves.

2ndly. That the secular magnetic changes cannot be concluded from comparatively short series of observations without giving to those observations extreme nicety, so as to determine with perfect precision the mean

state of the elements at the two extremes of the period embraced, which, as already observed, presupposes a knowledge of the casual deviations.

3rdly. It seems very probable that discordances found to exist between results obtained by different observers, or by the same at different times, may be, in fact, *not* owing to error of observation, but may be due to the influence of these transitory fluctuations in the elements themselves.

4thly and lastly, Because the theory of these transitory changes is in itself one of the most interesting and important points to which the attention of magnetic inquirers can be turned, as they are no doubt intimately connected with the general causes of terrestrial magnetism, and will probably lead us to a much more perfect knowledge of those causes than we now possess.

Actuated by these impressions, on the occasion of a letter addressed by Baron Von Humboldt to His Royal Highness the Duke of Sussex, P.R.S., the Council of this Society, on April 13, 1837, resolved to apply to Government for aid in prosecuting, in conjunction with the German Magnetic Association, a series of simultaneous observations; and in consequence of an application founded on such their resolution, a grant of money was obtained for the purchase of instruments for that purpose. By reason, however, of the details and manipulations of the methods then recently introduced into magnetic observations by Gauss, being at that time neither completely perfected, nor their superiority over the old methods fully established by general practice, the precise apparatus to be employed in these operations was not at the time agreed upon, and was still under discussion, subject to the report of the Astronomer Royal on the performance of an instrument on Gauss's principle established at Greenwich, at the time when the subject in its present more extended form was referred by the Council to this Joint Committee, so that the grant in question has not, in point of fact, been employed or called for. The Committee consider this as in some respects fortunate, as in consequence of the delay, time has been given for a much maturer consideration of the whole subject; and should it now be taken up as a matter of public concern, they consider that it will be necessary to provide for a more continuous and systematic series of observations, by observers regularly appointed for the purpose, and provided with instruments and means considerably more costly than those contemplated on the occasion in question.

On the general advisableness of calling for public assistance in the prosecution of the extensive subject of terrestrial magnetism, in both the modes referred to them for their consideration, (viz. by magnetic observatories established at several stations properly selected on land, and by a naval expedition expressly directed to such observations in the Antarctic Seas,) your Committee are fully agreed. They consider the subject to have now attained a degree of theoretical, as well as of practical, importance, and to afford a scope for the application of exact inquiry which it has never before enjoyed, and which are such as fully to justify its recommendation by the Royal Society to a revival of that national support to which we are indebted for the first chart of variations constructed by our illustrious countryman Halley in A. D. 1701, on the basis of observations collected in a voyage of discovery expressly equipped for that purpose by the British Government.

As regards the first branch of the question referred to their consideration, they are of opinion that the stations which have been suggested to them, viz. Canada, St. Helena, the Cape, Van Diemen's Land, and Ceylon (or Madras), are well selected, and perhaps as numerous as they could venture to recommend, considering the expense which would require to be incurred

at each, and that in each of these stations it would be desirable; 1st, That regular hourly observations should be made (at least during the daytime) of the fluctuations of the three elements of variation, dip, and intensity, or their equivalents, with magnetometers on the more improved construction, during a period of three years from their commencement.

2ndly. That on days, and on a plan appointed, agreed on in concert with one another, and with European observatories, the fluctuations of the same elements should be observed during twenty-four successive hours, strictly simultaneous with one another, and at intervals of not more than five minutes.

3rdly. That the absolute values of the same elements shall be determined at each station, in reference to the fluctuating values above mentioned, with all possible care and precision, at several epochs comprehended within the period allowed.

4thly. That in the event of a naval expedition of magnetic discovery being dispatched, observations be also instituted at each fixed station, in correspondence with, and on a plan concerted with the Commander of, such Expedition.

As regards the second branch of the subject referred to them, viz. the proposal of an Antarctic voyage of magnetic researches, they are of opinion, as already generally expressed, that such a voyage would be, in the present state of the subject, productive of results of the highest importance and value; and they ground this opinion on the following reasons:—

1st. That great and notorious deficiencies exist in our knowledge of the course of the variation lines generally, but especially in the Antartic seas, and that the true position of the southern magnetic pole or poles can scarcely even be conjectured with any probability from the data already known.

2ndly. That our knowledge of the dip throughout those regions, and the whole southern hemisphere, is even yet more defective, and that even such observations of this element as could be procured at sea, still more by landing on ice, &c., would have especial value.

3rdly. That the intensity lines in those regions rest on observations far too few to justify any sure reliance on their courses over a large part of their extent, and over the rest are altogether conjectural. Nevertheless that there is good reason to believe in the existence and accessibility of two points of maximum intensity in the southern, as in the northern, hemisphere, the attainment of which would be highly interesting and important.

4thly. That a correct knowledge of the courses of these lines, especially where they approach their respective poles, is to be regarded as a first, and, indeed, indispensable preliminary step to the construction of a rigorous and complete theory of terrestrial magnetism.

5thly. That during the progress of such an expedition, opportunities would of necessity occur (and should be expressly sought) to observe the transitory fluctuations of the magnetic elements in simultaneous conjunction with observations at the fixed stations, and in Europe, and so to furnish data for the investigation of these changes in localities very unlikely to be revisited for any purposes except those connected with scientific inquiries.

Your Committee, in making this Report, think it unnecessary to go into any minute details relative to the instruments, or other materials, required for the proposed operations, still less into those of the conduct of the operations themselves. Should such be required from them, it will then be time to

enter further into these and other points, when the Committee will most readily devote themselves to the fullest consideration of the subject.

J. F. W. Herschel,

Chairman of the Joint Physical and Meteorological Committee.

Resolutions of the Council.

1. That this Report be received and approved.

2. That the Council, deeply impressed with the importance of the scientific objects which might be attained by an Antarctic Expedition, particularly by the institution of magnetic observations in the southern regions, do earnestly recommend that Her Majesty's Government be pleased to direct the equipment of such an expedition.

3. That the imperfect state of our present knowledge of the amount and fluctuations of the magnetic elements, renders the establishment of fixed magnetical observatories, for a limited time, at various points of the earth's surface, highly desirable, particularly in Canada, St. Helena, Van Diemen's Land and Ceylon, and at the Cape of Good Hope; and that the Council do earnestly recommend Her Majesty's Government to cause such observatories to be established.

4. That a deputation, consisting of the President, Treasurer, and Secretaries of the Society, Sir John F. W. Herschel, the Chairman, and Major Sabine and Mr. Wheatstone, the Secretaries of the joint Committee of Physics and Meteorology, be requested to communicate the above Resolutions to Lord Melbourne, and to urge on the Government the adoption of the measures therein proposed.

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*Instructions for making Meteorological Observations.**

The suggestions which the Council wish to offer will relate, 1st, to the times of observation; 2ndly, to the situation of the instruments to be observed; 3rdly, to the correction of the observations; 4thly, to a form of registry, which may place many of the results in a striking point of view, and facilitate comparisons.

1. *Barometers.*

Times of observation.—The purposes of meteorological observations would be most perfectly and most expeditiously obtained by hourly observations throughout the year; but as at present such a course of unremitting labour cannot be hoped for, it is necessary to select periods, at longer intervals, calculated to embrace the extremes of the periodical oscillations to which the pressure of the atmosphere is subject, and to ensure that uniformity of system at different stations on which the value of such observations so much depends. It is probable that the hours of 3 A. M., 9 A. M., 3 P. M., and 9 P. M., nearly coincide with the daily maxima and minima of the barometric column at the level of the sea, over a large portion of the globe; and it is desirable that as extensive a comparison as possible should be instituted at these hours.

It is not, however, too much to expect that in regular observatories hourly observations should be made, for 24 hours, once in every month; and when this cannot be effected, it is of the utmost importance that they should be

*Extracted from "Instructions for the Scientific Expedition to the Antarctic Regions, prepared by the President and Council of the Royal Society of London."

made at least four times in the year, namely, at the summer and winter solstices, and at the spring and autumn equinoxes. One of the results of these hourly observations would, probably, be the indication of the exact times of the daily maxima and minima of pressure at different stations, which, if not found to coincide with the hours provisionally adopted, might ultimately be substituted for them under future directions.

Hourly observations at the equinoxes and solstices have been already instituted at numerous points both of Europe and America, at the suggestion of Sir John Herschel, whose directions should be strictly attended to. They are as follows:—

The days fixed upon for these observations are the 21st of March, the 21st of June, the 21st of September, and the 21st of December, being those, or immediately adjoining to those, of the equinoxes and solstices in which the solar influence is either stationary or in a state of most rapid variation. *But should any one of those 21st days fall on Sunday, then it will be understood that the observations are to be deferred till the next day, the 22nd.* The observation at each station should commence at 6 o'clock A. M. of the appointed days, and terminate at 6 A. M. of the days following, according to the usual reckoning of time at the place.

The commencement of each hour should be chosen, and every such series of observations accompanied by a notice of the means used to obtain the time, and, when practicable, by some observation of an astronomical nature by which the time can be ascertained within a minute or two.

The Council now propose to extend these observations in regular series to the 21st of every month, with the same reservation with regard to Sundays.

It is to be hoped that in regular meteorological observations the six-hourly observations may not be found to be impracticable throughout the year; but in any case where it may be impossible to observe regularly at 3 A. M., an effort should be made to include the hour on the days of the new and full moon, and quadratures, or at least on the days of the new and full moon;—as it must be borne in mind, that in what concerns the great meteorological questions on which the most interesting features of the subject depend, the night is quite as important as the day, and has been hitherto far too much neglected.

It is much to be wished that occasional observations may be made under remarkable circumstances, such as during great rises or great falls of the barometer, at the period of great storms, earthquakes, &c.; but such observations should be registered apart.

The barometer should be placed in an apartment subject to as little variation of temperature as possible, and in a good light; and to facilitate night observations, an arrangement should be made for placing behind it a light screened by a sheet of white paper, or other diaphanous substance. Great care should be taken to fix it in a perpendicular position by the plumb-line. Its height must be carefully ascertained above some permanent and easily-recoverable mark, either in the building in which it is situated, or in some more permanent building, or rock, in its immediate vicinity; and no pains should be spared to ascertain the relation which such mark may bear to the level of high and of low water at spring tides, and ultimately to the mean level of the sea.

Changes in the adjustments of meteorological instruments should be most carefully avoided; but whenever any alteration may be absolutely necessary, they should be made with all deliberation, scrupulously noticed in the re-

gister, and the exact amount of the change thence arising in the reading of the instrument under re-adjustment ascertained. As far as possible, registers of meteorological observations should be complete; but if, by unavoidable circumstances of absence, or from other causes, blanks occur, no attempts to fill them up by general recollection, or by the apparent course of the numbers before and after, should ever be made.

2. *Thermometers.*

Times of observation.—The external standard thermometer should be observed and registered at the same times as the barometer, and all the register thermometers may be read off at the time of the 9 A. M. observation, and their indices re-adjusted. But as double maxima frequently, and double minima occasionally, occur, in consequence of sudden changes of temperature, both the thermometers should be occasionally inspected with a view to ascertain whether the motion of either the mercury or the spirit has been reversed in an unusual manner; and such double maxima or minima should be recorded apart as *supernumerary*, with the dates and leading features of the case.

In placing the standard thermometer, an exposure should be chosen perfectly shaded from the sun, one where no reflected sunbeams from water, buildings, rocks, or dry soil, can reach it, and one which is easily accessible for observation. It should be *fixed*, not merely *hung*, upon a bracket projecting six inches from the wall, or other support to which it may be attached, and it must be *completely* sheltered from rain by a screen, so that the bulb shall never be wetted. In reading it, the observer should avoid touching, breathing on, or in any way warming, it by near approach of his person; and in night observations particular care should be taken not to heat it by approximation of the light. The quicker the reading is done the better.

Notice should, of course, be taken of all sudden and remarkable changes of temperature, although such occasional observations must not be recorded in the regular series.

The self-registering thermometers should be placed with the same precautions as the standard, and so fastened as to allow of one end being detached, and lifted up to allow of the indices within the tubes sliding down to the ends of the fluid columns, which they will readily do with the assistance of occasional tapping.

The self-registering thermometers are apt to get out of order by the indices becoming entangled, or from the breaking of the column of fluid. When this happens with the spirit thermometer, it may be rectified with ease by jerking the index down to the junction of the bulb and tube. The whole of the tube will at the same time become wetted with the spirit, and by setting it on end with the bulb downwards the spirit will run together into one continuous column.

When the steel index of the mercurial thermometer becomes immersed in the mercury, it must be jerked in the opposite direction, till it, with the mercury which may be above it, is projected into the little bulb at the top of the tube. If this do not succeed, heat must be applied to the mercury-bulb, and when the index is fairly lodged in the air-bulb, by carefully warming the mercury-bulb with a spirit lamp having a very small flame, the mercury must be made to expand till it rises to the very top of the tube, and projects convexly into the air-bulb. The tube must then be placed upright, and, by tapping, the detached mercury will slip down beneath the steel index, and will fairly unite with the convex projection aforesaid. Now let the bulb

cool, and the mercury will sink in one united column, and leave the index free.

Besides the regular series of observations of the temperature of the air, there are other occasional observations to be made of temperature under different circumstances, which might possess great interest.

The surface temperature of the water of the sea or of rivers may be conveniently obtained by taking up a bucket-full of water and stirring round the thermometer in it.

The temperature of the water of deep wells may be ascertained in the same way, and should be taken monthly, if near the residence of the observer. The temperature of rain should also be attended to at times; it may be determined by receiving the rain in a *linen* funnel, totally enclosed in a tin case to prevent cooling by evaporation from the linen.

The temperature of the soil at different depths is a point of considerable importance. For this purpose excavations should be made in a dry sheltered situation, 3, 6, and 9 feet deep, and lined with brick or earthenware tubes. In the bottom of these excavations earthenware quart bottles may be carefully placed, filled with water, spirit, or brine, and corked. They must be carefully covered with tow or cotton, and drawn up on the 21st of every month (being the day of horary observation), and their temperatures taken by an accurate thermometer, and registered apart.

As a general caution it may be mentioned, that the *standard* thermometer should never be exposed to risk by application to such purposes, but thermometers which have been compared and corrected by comparison with it.

3. *Actinometers.*

Amongst the observations of highest importance must be ranked those of the force of solar and terrestrial radiation. The most perfect means of observing the former is afforded by the actinometer.

This instrument consists of a large hollow cylinder of glass, soldered at one end to a thermometer-tube, terminated at the upper end by a ball drawn out to a point, and broken off, so as to leave the end open. The other end of the cylinder is closed by a silver or silver-plated cap, cemented on it, and furnished with a screw, also of silver, passing through a collar of waxed leather, which is pressed into forcible contact with its thread, by a tightening-screw of large diameter enclosing it, and working into the silver cap, and driven home by the aid of a strong steel key or wrench, which accompanies the instrument.

The cylinder is filled with a deep blue liquid (ammonio-sulphate of copper), and the ball at the top being purposely left full of air, and the point closed with melted wax, it becomes, in any given position of the screw, a thermometer of great delicacy, capable of being read off on a divided scale attached. The cylinder is enclosed in a chamber blackened on three sides, and on the fourth, or face, defended from currents of air by thick glass, removable at pleasure.

The action of the screw is to diminish or increase at pleasure the capacity of the hollow of the cylinder, and thus to drive, if necessary, a portion of the liquid up into the ball, which acts as a reservoir; or, if necessary, to draw back from the reservoir such a quantity as shall just fill it, leaving no bubble of air in the cylinder.

To use the instrument, examine first whether there be any air in the cylinder, which is easily seen by holding it level, and tilting it, when the air, if

any, will be seen to run along it. If there be any, hold it upright in the left hand, and the air will ascend to the root of the thermometer-tube. Then, by alternate screwing and unscrewing the screw with the right hand, as the case may require, it will always be practicable to drive the air out of the cylinder into the ball, and suck down liquid, if any, from the ball, to supply its place, till the air is entirely evacuated from the cylinder, and the latter, as well as the whole stem of the thermometer-tube, is full of the liquid in an unbroken column. Then, holding it horizontally, face upwards, slowly and cautiously unscrew the screw, till the liquid retreats to the zero of the scale.

The upper bulb is drawn out into a fine tube, which is stopped with wax. When it is needed to empty, cleanse, and refill the instrument, liquid must first be forced up into the ball, so as to compress the air in it. On warming the end, the wax will be forced out, and the screw being then totally unscrewed, and the liquid poured out, the interior of the instrument may be washed with water slightly acidulated, and the tube, ball, &c. cleansed, in the same way, after which the wax must be replaced, and the instrument refilled.*

4. *Radiating Thermometers.*

As, however, the actinometer can only be observed at intervals in perfectly clear weather, additional information with regard to solar radiation, of much interest, though not of so precise a nature, may be obtained, by the daily register of the maximum temperature of a register thermometer, with a blackened bulb exposed to the full action of the sun's rays. It may be placed about an inch above the bare soil, and screened from currents of air. The maximum temperature indicated by such a thermometer, even in cloudy weather, will generally be considerably above that of the air, and the maxima and mean daily maxima of its indications will, after a long series of observations, afford data of the utmost value to the history of climates. The bulb of the thermometer should be about half an inch in diameter, and it may be uniformly blackened with lamp-black and varnish. The graduation should be made upon the glass stem, to prevent any inconvenience from the expansion and warping of the scale.

The measure of terrestrial radiation is of no less importance to the science of meteorology than that of solar radiation, but no perfect instrument has yet been contrived for its determination. Very valuable information, however, may be derived from the daily register of the minimum temperature of a register spirit-thermometer, the bulb of which is placed in the focus of a parabolic metallic mirror, turned towards the clear aspect of the sky, and screened from currents. The mirrors furnished to the observatories are of silver-plated copper, but planished tin-plate or zinc might be substituted without detriment. They are 6 inches diameter and 2 inches deep, and the thermometers which are graduated upon the stems pass through sockets in their sides, in which they may be accurately adjusted by corks. Their bulbs do not exceed half an inch in diameter.

Even in the day time a thermometer so placed, and turned towards the clear sky, but away from the rays of the sun, will fall several degrees below the temperature of the surrounding air.

*Rules for making an observation with the Actinometer will be found in the Lond. & Ed. Phil. Mag. for Sep. 1839.

5. *Hygrometers.*

Times of observation.—Observations of the *dew-point* hygrometer are as desirable at the regular hours as those of the other meteorological instruments; but, as more difficulty attends the observation, it is more liable to omission, and it is of great importance that when one experiment only can be made, the most advantageous hour should be selected for the purpose. Now it is probable that the minimum temperature of the air in the 24 hours may correspond with the minimum temperature of the dew-point; and for the attainment of a mean result, the time of the highest dew-point should be selected, which would not differ much from 3 P. M., at which hour the observation should on no account be omitted. The hygrometer should also be observed, if possible, at 9 A. M. and 9 P. M., but the minimum temperature might probably be substituted for the 3 A. M. observation without any material error.

Occasional observations of the dew-point under peculiar circumstances, as for instance in the inhabited apartments of houses, or between the decks of the ships when laid up in their winter quarters in the polar regions, could not but afford information of high practical importance.

All the ether of the dew-point hygrometer should be driven by the warmth of the hand from the covered, into the uncovered ball, previously to an observation, and the ether should be dropped from a dropping-bottle very slowly upon the former. The temperature of the interior thermometer should be carefully noted upon the first appearance of the ring of dew upon the black bulb, and also its temperature upon its disappearance: the mean of the two observations, should they differ, may be entered as the dew-point, together with the temperature of the air by the exterior thermometer.

The *wet-bulb* hygrometer can be observed without difficulty, by mere inspection, and the observation should never be neglected at the regular hours. It is probable that the temperature of evaporation thus ascertained may afford the means of accurately determining the dew-point, and of solving all the points of hygrometry; but until all the necessary corrections shall have been agreed upon, one of the most essential requisites must be its frequent and accurate comparison with the dew-point, directly ascertained.

The hygrometers should be placed in the observatory, near to the standard thermometer, with which they should be frequently compared.

6. *Vanes, Anemometers, and Rain Gauges.*

Those who do not possess a register-anemometer may make use of the common vane and Lind's wind-gauge. The position of the former should be clear of all deflections and eddies from objects of the same or a higher level, and of course its position with regard to the true north should be clearly determined. In registering the direction of the wind it may be sufficient to use only 16 points of the compass.

Lind's wind-gauge for measuring the force or momentum of the wind is adjusted for use by filling it with water till the liquid in both legs of the siphon corresponds with the 0° of the scale. It is to be held perpendicularly, with the mouth of the kneed tube turned towards the wind, and the amount of the depression in one leg, and that of its elevation in the other, are to be carefully noted. The sum of the two is the height of a column of water which the wind is capable of sustaining at the time, and every body that is opposed to that wind will be pressed upon by a force equivalent to the weight of a column of water, having its base equal to the surface that is opposed,

and its height equal to the altitude of the column of water sustained by the wind in the wind-gauge.

The height of this column being given, the force of the wind on a foot square is easily found by a table which will be given in the appendix.

The observation of the gauge should always be made at the same point of a free space, and in gusty weather the maximum of the oscillation recorded. The most proper periods will be those of the other regular observations; but in great storms, or under other particular circumstances, occasional observations should be made, and registered apart.

The points most important to remark respecting the wind are,

1st. Its average intensity and general direction during the several portions of the day devoted to observation.

2ndly. The hours of the day or night when it commences to blow from a calm, or subsides into one from a breeze.

3rdly. The hours at which any remarkable changes of its direction take place.

4thly. The course which it takes in veering, and the quarter in which it ultimately settles.

5thly. The usual course of *periodical winds*, or such as remarkably prevail during certain seasons, with the law of their diurnal progress, both as to direction and intensity; at what hours, and by what degrees they commence, attain their maximum, and subside; and through what points of the compass they run in so doing.

6thly. The existence of crossing currents at different heights in the atmosphere, as indicated by the courses of the clouds in different strata.

7thly. The times of setting-in of remarkably hot or cold winds, the quarters from which they come, and their courses, as connected with the progressive changes in their temperature.

8thly. The connexion of rainy, cloudy or fair weather, with the quarter from which the wind blows, or has blown for some time previously.

The rain-gauge may be of very simple construction. A cubical box of strong tin or zinc, exactly 10 inches by the side, open above, receives, at an inch below its edge, a funnel, sloping to a small hole in the centre. On one of the lateral edges of the box, close to the top of the cavity, is soldered a short pipe, in which a cork is fitted. The whole should be well painted. The water which enters this gauge is poured through the short tube into a cylindrical glass vessel, graduated to cubic inches and fifths of cubic inches. Hence one inch depth of rain in the gauge will be measured by 100 inches of the graduated vessel, and $\frac{1}{1000}$th inch of rain may be very easily read off.

It is very much to be desired that, being of such easy construction, more than one of these gauges should be erected, or at least one placed with its edge nearly level with the ground, and another upon the top of the highest building, rock, or tree, in the immediate vicinity of the place of observation, the height of which must be carefully determined; it having been satisfactorily ascertained that the height of the gauge above the ground is a very material element in the quantity of rain which enters it. The quantity of water should be daily measured and registered at 9 A. M.

7. *Clouds and Meteors.*

Many very highly-interesting observations may be made, without the aid of instruments, upon the clouds. In describing them, Mr. Howard's nomenclature may be adopted with great advantage. By means of the clouds, different simultaneous currents of wind may often be detected, the different

directions of which should be carefully ascertained by referring their motions to some fixed object. Their gradual evaporation or precipitation should also be carefully noted, and particularly their regular disappearance at night, or their more irregular and sudden formation.

Rainbows, parhelia, haloes, &c., will of course be noted amongst the occasional remarks of the register; and an attempt should be made to express approximatively by numbers, the proportion which the overcast portion of the sky may bear to the clear space. For this the hemisphere may be supposed to be divided into eight sections, and the cloudy portion may be expressed by the fraction $\frac{1}{8}$th or $\frac{3}{8}$ths, &c.

8. *Electrometers.*

The Council are fully impressed with the high importance of regular observations on the electrical state of the atmosphere; but they are not prepared to suggest any means of effecting this desirable object, which will at all correspond with the present advanced state of electrical physics. At no distant period they hope to supply a defect which is certainly a reproach to science. In the meantime much valuable information might be acquired by observations of an electroscope, on one of the ordinary constructions connected with a lofty insulated wire.

In erecting such a wire, proper precautions should be taken against accidents by preparing a sufficient conductor in its immediate vicinity, by which a communication could be at once opened with the ground in case of any sudden and dangerous accumulation of the electric fluid.

As a temporary contrivance, a common jointed fishing-rod, having a glass stick well varnished with shell lac, substituted for its smallest joint, may be projected into the atmosphere. To the end of the glass must be fixed a metallic wire terminating in a point, and connected with an electroscope by means of a fine copper wire. If the wire be made to terminate in a spiral wrapped round a piece of cotton dipped in spirits of wine and inflamed, its power of collecting electricity will be sometimes doubled, but great precautions are necessary when this mode is employed. When the electroscope has been charged, the nature of the electricity may be tested in the usual way by excited glass or sealing wax.

The observations made with the principal, existing instruments have demonstrated that in serene weather the electricity of the atmosphere is always positive with regard to that of the earth, and that it becomes more and more positive in proportion to its elevation above the earth's surface; so that if an observer be on a mountain, or in a balloon, if his conductor be directed downwards to reach an inferior stratum of air, his electroscope will indicate negative electricity; and if it be sent upwards into a superior stratum, positive electricity will be manifested. Various means have been resorted to in these experiments, such as connecting one of the extremities of the conducting wire to a kite, a small balloon, or the head of an arrow, the other extremity remaining attached to the electroscope.

It has been ascertained by the observations of De Saussure, Schubler, Arago and others, that the positive electricity of the atmosphere is subject to diurnal variations of intensity, there being two maxima and two minima during the twenty-four hours. The first minimum takes place a little before the rising of the sun; as it rises, the intensity, at first gradually and then rapidly, increases, and arrives at its first maximum a few hours after. This excess diminishes at first rapidly and afterwards slowly, and arrives at its minimum some hours before sunset; it re-ascends when the sun approaches

the horizon, and attains its second maximum a few hours after, then diminishes till sunrise, and proceeds in the order already indicated. The intensity of the free electricity of the atmosphere has also been found to undergo annual changes, increasing from the month of July to the month of November inclusive, so that the greatest intensity occurs in winter, and the least in summer.

In cloudy weather the free electricity of the atmosphere is still positive. During storms, or when it rains or snows, the electricity is sometimes positive and sometimes negative, and its intensity is always much more considerable than in serene weather. The electroscope will, during the continuance of a storm, frequently indicate several changes, from positive to negative.

Very recently, a new method of investigating the electric state of the atmosphere has been proposed, likely to lead hereafter to very certain and valuable results; but it has not been sufficiently put in practice to enable the Council to recommend, at the present moment, the best form of instrument for making simultaneous and comparable observations, or the proper precautions to guide the observer in manipulating it.

For the principle of this instrument we are indebted to Mr. Colladon of Geneva. He found, that if the two ends of the wire of a galvanic multiplier, consisting of very numerous coils well insulated from each other, were brought in contact, one with a body positively, and the other with a body negatively charged, a current of electricity passes through the wire, until equilibrium is restored; the energy and direction of this current is indicated by the deviation of the needle from the zero point of the scale. This instrument is applied to the purpose of ascertaining and measuring the atmospheric electricity, by communicating one end of the wire with the earth, and allowing the other to extend into the region of the atmosphere, the electrical state of which is intended to be compared.

Thunder storms, of course, should be attended to; but it is of consequence also to notice distant lightning not accompanied with thunder audible at the place of observation, especially if it take place many days in succession, and to note the quarter of the horizon where it appears, and the extent which it embraces. In an actual thunder storm, especial notice should be taken of the quantity of rain which falls, and of the fits or intermittences of its fall, as corresponding, or not, to great bursts of lightning, as also of the direction of the wind, and the apparent progress of the storm with or against it.*

Progress of Civil Engineering.

On the Attractive force of a Blast of Air.

When compressed air escapes through an orifice, a very singular phenomenon may be shown, which has not yet found its way into our books of science, although it is well known on the continent. This phenomenon can be exhibited by the following simple experiment:—

If we cut a couple of cards each into a disk of about two inches in diameter, and perforate one of these at the centre, and fix it on the top of a tube, such as the barrel of a common quill; then if we give the other card a little concave bend, and place it over the first, the orifice of the tube being thus

*On these subjects the Council especially recommend the attentive perusal of Arago's *Notice sur le Tonnerre.*

directly under and almost in contact with the upper card; now, if we try to blow off the upper card, we shall find it impossible to be done.

This remarkable fact seems to have been noticed by several persons independently of each other. The French bring forward no less than three claimants, namely, M. Griffith, Mining Engineer of Fourchambault, and Messrs. Boigues of the same place, who showed the fact to Messrs. Thenard and Clement in September, 1826. About this time also the same fact appears to have been noticed by Mr. Roberts, an intelligent manufacturer of Manchester. We here give the several accounts of the discovery.

M. Griffith says that, if air be powerfully compressed in a reservoir furnished with a circular opening in one of its vertical sides, and we present to the blast of air issuing therefrom a flat piece of board or metal, it will at first be repelled by the violence of the blast; but after forcing it nearer to the aperture, so as to overcome this repulsion, it will be powerfully attracted. In this position the air escapes by diverging between the interior surface of the board or metal, and the rim of the orifice.

The account of Messrs. Boigues is as follows:—A circular opening, one or two inches in diameter, being made in the flat side of a reservoir of compressed air, employed to feed a blast furnace, the air escapes with great violence; but, if we bring near to this opening a disk of wood or metal seven or eight inches in diameter, and having overcome the resistance caused at first by the blast upon the plane surface of the disk, the latter will no longer be repelled; it oscillates rapidly, at the same time receding from and approaching to the opening within very narrow limits. The air continues to escape with great noise between the surface of the disk, and that of the side of the vessel containing the air. If now we wish to withdraw the disk, it will require great muscular exertion to do so; and although the disk be not in actual contact with the side of the air-vessel, it seems as if glued to it.

The next discoverer of this phenomenon is our countryman, Mr. Roberts. Several years ago he had constructed an apparatus for ventilating his manufactory. A pipe, conveying a blast of air, terminated close to the wall of the principal apartment; and with a view to regulate the quantity of air to be introduced, he placed a valve over the terminus of the blast-pipe; but found, to his surprise, that the most powerful blast of air not only would not lift the valve, (which was merely a piece of flat board,) but that it even held the valve firmly down over the mouth of the pipe, so that the strength of one man was insufficient to withdraw it. This experiment has often been shown to visitors as one of the curiosities of Manchester.

This phenomenon can be produced by a blast of any kind of gas or vapour; by steam, and even by water, and other liquids.

The attractive force of a blast of air is particularly remarkable, if we place the card, mentioned at the beginning of this article, with its concave side upwards upon the table, and, with the tube in the mouth, hold the other card over it, and blow through the tube, when the concave card will start up from the table, and adhere to the other.

It has been stated in reference to the experiment with the cards, that the upper card cannot be blown off, because the current of air, which passes between the two cards in consequence of blowing through the tube, is in a more rarefied state than the atmosphere around and above; and that therefore the latter presses upon the two cards, so long as the blast is kept up and causes them to adhere.

But to show that the upper card is not retained in its place merely by atmospheric pressure, the following experiment was performed by Mr. Tom-

linson. Let a brass tube, open at both ends, and terminated at the lower end by a perforated screw, be fixed to the table of the air-pump. A disk of card, two inches in diameter, is placed horizontally at the upper end of the tube. Another card of the same size, made slightly concave, is placed over the first. Let the whole be covered with a glass receiver: then let the air be removed, which of course can only quit the receiver by passing out through the brass tube; when the exhaustion is carried to its utmost limit, let the air be re-admitted in a full gush through the brass tube, and the upper card will *not* be blown off.

This experiment has been tried many times, with various states of exhaustion, from a quarter of an inch of mercury to 20 inches; but in no case was the card blown off, or even agitated in the slightest degree: therefore the upper card is not retained in its position by the pressure of the atmosphere, but is retained in its place from this circumstance; that when a fluid issues from an open tube, the lateral or side pressure of such fluid amounts to nothing. This is an extraordinary fact, and we will endeavour to make the proof of it as simple as possible.

It is a well-known property of fluids that they transmit their pressure equally in all directions; but this law applies only to fluids in a state of rest. When they are in motion, they are subject to the laws which regulate the motions of solids, and do not transmit any lateral pressure, except when they meet obstacles to their onward motion. In proof of this conclusion we refer to an elegant experiment of Bossuet.

To a large reservoir of water, a horizontal tube was attached, three feet in length, and three quarters of an inch in diameter, and about the middle of this tube was made a small lateral hole, for the formation of a *jet d'eau*, the pipe being so adjusted, that the hole might be directed upwards, downwards, or sideways, by merely turning the tube on its axis. The water in the reservoir was kept to the height of four feet above the tube; and the extreme end of the latter being closed, the *jet d'eau* was immediately formed. When the hole was upwards, the jet rose very near to the surface of the water in the reservoir. The jet was obtained in like manner, whichever way the hole was turned. The end of the tube was now opened, the water began to flow out at it, and the jet ceased almost entirely. It was only observed that, when the hole was turned below, the water escaped in drops. The cessation of the jet clearly proves the cessation of the pressure of the water against the sides of the tube.

The young student may perform a similar experiment by taking a tube, (such as a pea-shooter or a tube of paper will do), and making a hole in the side. Then, if we put one end of this tube in the mouth, and stop up the other end, and blow, the air will rush out at the side-hole; but if we open the lower end, we shall, on blowing, be scarcely able to feel the air coming out from the side-hole. In the one case the air from the side-hole will blow out a candle; which it will not do when the tube is open at both ends.*

The reason then why the upper card cannot be blown off is this; the first impact of the blast tends, of course, by its momentum, to force off the upper

*Not only will there be no outward jet of water or current of air from a lateral opening in a tube through which a current of water, or of air, is rapidly flowing, but both air and liquid will be *drawn in* to such a current or stream from the air or liquid surrounding the tube. This is demonstrated by an interesting experiment of Venturi. (Enquiries on the lateral communication of motion to fluids; or, Cavallo's Philosophy, Hydraulics, Chap. VII.); and to the pressure occasioned by the draught of air *into* the diverging current between the two disks, should be ascribed their

card; and, if this be not done at once, the current of air spreads out into a film, and escapes at the circumference of the disks, and in so doing its motion is altogether lateral—the pressure of which, as we have seen, amounts to nothing: therefore the disk is not removed, because there is, in fact, no force to effect its removal.

This little experiment, trifling as it may appear, is, however, of first-rate importance, and may possibly serve to throw light upon some of the terrific explosions of steam-boilers. It is possible, under certain conditions, that the blast of steam which escapes at the safety-valve may become reduced to a thin film with a lateral motion, and consequently without pressure; so that the valve, instead of being lifted up, to allow a full and free vent to the steam, may become attracted, which attraction would increase with the elasticity of the steam, and so precipitate the danger which the valve was intended to counteract.

Mech. Mag.

On the most Economical Proportion of power to Tonnage in Steam Vessels. By Mr. Scott Russell.

It is a subject of anxious inquiry with every proprietor and constructor of steam vessels, when about to construct a new steam vessel for a given station, What is the best amount of power to place in my ship, so as to accomplish, in the highest degree, economy, rapidity, and regularity? The inquiry is one accompanied with difficulties. If, on the one hand, a large cargo is desired, which is generally the case, the power of the engine is made small, for the purpose of occupying small bulk, and consuming little coal; and although less velocity is then acquired than with greater power, still less fuel is consumed with a small engine than a large one, and thus it is supposed that greater economy is effected. This maxim, of a small proportion of power to tonnage, is one on which many companies have long continued to act. In other cases, where velocity is absolutely required, a much larger proportion of power has been employed, and, of course, by a large power there is a much greater consumption of fuel than a small one in a given time; and not only so, but it is well known that this additional consumption is much greater than in the proportion of the velocity gained; so much so, that a consumption of four times as much fuel will not give more than about double the velocity. Thus, it has appeared that the use of very great powers, and great expenditure of fuel, have been made with only a very slight increase of velocity. All this, the usual reasoning on the subject, goes to prove the value of employing a small proportion of power to tonnage for economy. The advantage of low powers and of low velocities, in point of economy, would thus appear to be established: but this apparent advantage in theory has not been realized; on the contrary, it may be recollected, that at the Bristol Meeting of the Association, Dr. Lardner remarked, that in a case which had come under his own knowledge, where the power had become gradually increased in the same vessel, and it was found that while

proximate adhesion, which seems to be left unaccounted for by the writer of the above paper. In the ingenious experiments of Hopkins Roberts, (Jour. Frank. Inst. Vol. X, p 188), the persisting force is ascribed to atmospheric pressure arising from an attenuated state of the compressed diverging current. This conflicts with the experiments of Tomlinson above recited; but the reasoning from those experiments appears to be inconclusive. G.

the vessel was increased in speed, the consumption of fuel on the whole had diminished. This was a fact which Dr. Lardner attributed to Mr. Russell's wave principle. Mr. Russell had himself attributed it at that time to the same cause, but he had afterwards considered the subject worthy of further examination. He examined the books of the expenditure of fuel in the steam vessels of several companies, and found that they were aware that they had, on the whole, saved money by using high powers of steam and high velocities, instead of low ones. This result he would not in the circumstances attribute to his wave principle; and he had, therefore, examined it carefully, and had arrived at a very remarkable general result, which appeared to him quite new, and to be of very great value at the present moment, when such important interests were involved in the successful extension of deep sea navigation. The general principle at which Mr. Russell had arrived, was this:—*That in a voyage by a steam vessel in the open sea, exposed, of course, to adverse winds, there is a certain high velocity and high portion of power, which may be accomplished with less expenditure of fuel and of room, than at a lower speed with less power.* This principle he then proceeded to prove, and to illustrate by the following case, in which the same vessel is taken with different powers of engine, and the result, as regards expenditure of fuel, determined first arithmetically, and then by a general formula, which will enable any one to determine any particular case.

Fair Weather.

1,200 tons, 400 horse-power, 9 miles an hour, 216 miles per day, 1 ton of coals per hour.—2,160 miles in 10 days, 240 tons of coal.

1,200 tons, 500 horse-power, 10 mile an hour, 240 miles per day, $1\frac{1}{4}$ ton of coal per hour.—2,160 miles in 9 days, 270 tons of coal.

Adverse Weather.

1,200 tons, 400 horse-power, 5 miles per hour, 120 miles per day, 1 ton of coals per hour.—2,160 miles in 18 days, 436 tons of coal.

1,200 tons, 500 horse-power, $6\frac{3}{4}$ miles per hour, 162 miles per day, $1\frac{1}{4}$ ton of coals per hour.—2,160 miles in 13 1-5th days, 395 tons of coal.

General Formula.—Let v represent the velocity of a given steam vessel in a favourable voyage; v' the same vessel in an unfavourable voyage; v'' a vessel, higher power, favourable voyage; v''' unfavourable voyage; p the power of the former vessel; p' latter vessel:—

$$\therefore \sqrt{v'''-(v-v')} = v''' = \sqrt{v}\sqrt{\frac{p'}{p}-(v-v')}\ v\frac{p'}{p} = \sqrt{\frac{v''-(v-v')}{v'}}$$

in the case of equal expense, whence the highest proportion of power that will be economical in fuel may be at once obtained.

Dr. Lardner remarked that the theory of Mr. Russell was quite new to him; but, after the exposition which he had heard, he was satisfied of its accuracy.—Mr. Russell observed that there was another important circumstance to which he had not alluded, and in which great advantage might be derived from the application of a high power: thus the owner of a vessel which usually accomplishes her voyage in fifteen days, but owing to storms or adverse winds, occasionally takes twenty, must so regulate her stated periods of departure as to allow for these adverse circumstances; and four or five such vessels may be required to keep up a regular communication between places for which three or four would be sufficient, if, by increased

power, the average voyage were reduced to ten, and the adverse to fourteen days; and thus a large capital would be saved, as well as more voyages accomplished. The principles which he had developed might also, he thought, be applied advantageously under many other circumstances,—such as in mines subject to uncertain in-rushing of water, &c. In reply to a question, Mr. Russell stated that his principle was only true in reference to vessels making long voyages, for, where not exposed to adverse contingencies of wind and weather, a great additional power would be merely an additional expense.

Athenæum.

Great Western Railway.—The Box Tunnel.

One of the greatest obstacles to the accomplishment of this stupendous undertaking was found to exist in Box Hill, a large extent of elevated ground lying directly between, and about equi-distant from, Chippenham and Bath. This hill, the highest part of which is about four hundred feet above the proposed level of the rail road, could not be avoided; to make an open cutting through it was impossible, and to perforate it was thought by many equally so. Nevertheless Mr. Brunel, with that boldness for which he is so celebrated, adopted the latter plan, and accordingly it was determined that a tunnel, one mile and three quarters in length, forty feet in height, and thirty feet in width, should be made through the hill. The extraordinary attempt of boring through this immense mass, consisting in great part of solid beds of free-stone, was commenced in the summer of 1836, and will, it is hoped, be completed in 1841. The difficulties that have stood in the way of the performance of this great work, particularly that part of it on the east, or Chippenham, side, have been appalling; but hitherto they have been surmounted by the enterprise, skill, and perseverance of Mr. Brewer, of Rudloe, and Mr. Lewis, of Bath, the gentlemen who contracted with the directors for the completion of that portion of the work. Their contract extends from shaft No. 8, which is sunk at the proposed mouth of the tunnel on the east side, to a point three hundred yards towards Shaft No. 6, and altogether 2,418 feet from the entrance at the Chippenham end, this portion Messrs. Brewer and Lewis confidently expect to be able to finish in January next.

Independent of the difficulties arising from the laborious nature of the undertaking, the constant flow of the water into the works from the numerous fissures in the rock has been constantly most annoying, and in the rainy season so formidable as almost to destroy all hope of being able to contend with it. In November, 1837, the steam-pump then employed being quite inadequate to the task of making head against it, the water increased so fearfully, having filled the tunnel, and risen to the height of fifty-six feet in the shaft, as to cause the total suspension of the work till the July following. This would have caused many persons to have abandoned the work in despair, but Messrs Brewer and Lewis determined to fulfil their contract if possible, erected a second pump, worked by a steam-engine of fifty-horse power, and had the satisfaction of vanquishing their enemy and resuming their work. A few months afterwards (in Nov. 1838) the works were again stopped by an influx of water, which, however, was got under in ten days, the engine discharged 32,000 hogsheads of water a day.

The tunnel between Shafts No. 7 and 8 (1,520 feet in length) is entirely finished at the roof, and for six feet below it, where the base is fourteen feet wide; but half-way between the two shafts there still remain about three

hundred and fifty feet of cutting to be done, which is expected to be cleared away some time next month. In this portion of the work Messrs. Brewer and Lewis commenced their operations at each end, working towards the centre; and when the two cuttings closely approximated, much anxiety was felt lest a straight line should not have been kept, and the union of the two portions of the work should not have been true; but on breaking through the last intervening portion of the rock the accuracy of the headings was proved; to the joy of the workmen, who took a lively interest in the result, and to the triumph of Messrs. Brewer and Lewis' scientific working, it was found that the junction was perfect to a hair as to the level, the two roofs forming an unvarying line, while at the sides, the utmost deviation from a straight line was only one inch and a quarter. This, in a cutting of 1,520 feet in length, begun, at opposite ends, and worked towards a common centre is, perhaps, unexampled in the annals of tunneling.

The cutting on the Chippenham side has hitherto been, and it has already extended two thousand feet, through one solid bed of freestone or superior oolite, in many places one hundred and thirty feet thick, and lying upon a bed of fuller's earth, or clay, one hundred and twenty feet in thickness; under which, blue marl, resting upon lias clay, is found. So uninterrupted and compact is the rock through which this end of the tunnel passes, that no masonry is required in any part of it, the stone itself forming sides and roof, and nothing being required at the bottom but the rails on which the carriages will run.—*Abridged from the Wiltshire Independent.*

Civ. Eng. & Arch. Jour.

Railway Level Gauge.

Dr. Lardner described an apparatus which he had constructed for use in working railways: From various circumstances which he had observed, he was of opinion, that the rails were often not so perfect as they ought to be, and he had hence thought it advisable to make some experiments to ascertain their rate of deflection, his object being to form an idea of their relative merit of surfaces. He made use of a truck, with wheels without flanches and perfectly cylindrical, and on which a platform was placed. An iron tube crossed this, terminating at each end at right angles, and into this was introduced mercury, so that it was in fact a mercurial level. On placing this along the lines of railway the columns were found to go up and down, an effect which was not produced by oscillation. Into these columns was introduced a piston rod, to the top of which a pencil was attached, which on any incorrectness of the line described a curve on a sheet of paper, the ordinate of which gave the variation of the rail. He had tried this on several parts of a line, where it gave a continual variation in the curve, amounting even from three to five inches. The instrument was checked so as to show that this curve was the real representation of the line, and, being simple and easily applied, would no doubt be found useful to contractors on new lines of rails.

Athenæum.

Prices of Railway Shares in England.

The following table shows the prices of railway shares in England. Those finished are marked (1); in progress (2); which have their Bills, but are not yet begun (3); others (4).

Those marked with a * are the Liverpool prices, which are to the 26th inclusive. † Scotch. ‡ Manchester. § Carlisle. The others are London prices to the 28th July.

NAMES OF RAILWAYS.	No. of Shares.	Share.	Paid.	Prices sold at.			Dividend per cent.
				Highest.	Lowest	Latest Price.	
(2) Birmingham and Derby,	6,300	100*l*	70*l*	64	62½	64	
(2) Birmingham and Gloucester,	9,500	100	50	32¼	29	32¼	
(2) Birm., Brist., & Thames Junc.	7,500	20	18			9	
(2) Bristol and Exeter,	15,000	100	25	10¾	10	10	
(2)‡Bolton and Preston,	7,000	50	20	11½	11	11	
(2)‡Cheltenham and Great Western,	7,500	100	35	11	10	10	
(2)*Chester and Crewe,	5,000	50	30	19½	19½	19½	
(2)*Do., Birkenhead,	5,000	50	35	42½	40¼	42	
(2) Commercial, Blackwall,	24,000	25	11	10	8	9⅞	
(2)‡Dublin and Drogheda,	6,000	100	10	8	8	8	
(2)*Eastern Counties,	64,000	25	16	10⅛	7⅜	7⅜	
(2)*Edinburgh and Glasgow (old),	18,000	50	10	10⅛	10⅛	10⅛	
Ditto, ditto (new)	5,000		5			4	
(2) Edinburgh, Leith, & Newhaven	5,000	20	7			4	
(2)†Glasgow, Paisley, & Greenock,	16,000	25	18	10	9¾	10	
(2)†Glasgow, Paisley, & Ayrshire,	12,500	50	20	16	15	16	
(1)*Grand Junction,	10,400	100	100	204	202	203	12
(2) Gosport Junction,	6,000	50	5	8½	7½	8	
(2) Great Leinster and Munster,	8,000	100	5			18*s* 6*d*	
(2) Great North of England,	10,000	100	35	26	25	25	
(2)*Great Western,	25,000	100	65	73	71	72	
*Do. new,				3¾pm.	2⅝pm.	3⅛pm	
(4) Harwich,	11,000	20	1			⅝	
(2)‡Hull and Selby,	8,000	50	30	19½	15	19½	
(2) Llanelly Railway & Dock Co.,	2,000	100	70			70	7½
(1)*Liverpool and Manchester,	7,968¾	100	100	196	195	195	10
*Ditto ¼ shares,	546	25	25	46½	46½	46½	
*Ditto ½ shares,	7,968	50	50	76	75½	75¾	
(1)*Leicester and Swannington,	1,500	50	50	73½	70½	73½	8
(2) London and Brighton,	36,000	50	22	12⅝	11⅜	11½	
(1) Do. and Birmingham,	25,000	100	90	166	160	166	
Do. ¼ shares,	25,000	25	5	27½	27	27	
Do. New Shares,			8	25¼	24	25¼	
(1) Do. and Greenwich,	20,000	20	20	16½	15½	15½	3
Do. New Shares,			20	19½	19½	19½	
(2) Do. and Southampton,	20,000	50	50	45½	43½	45	
Do. do. New,	16,000	25	25				
(1) Do. and Croydon, Trunk,	20,000	20	16⅞	12⅛	10	10½	
Do. New Scrip,	6,666	20	10½			8¼	
(1)‡Leeds and Selby,	2,100	100	100	70	70	70	
(2) Manchester and Birmingham,	30,000	70	15	12	9½	10⅜	
(4) Do. and do. Extension,	15,000	70	7	5¼	3¼	3¼	
(2) Do. and Leeds,	13,000	100	50	69½	59½	69½	
‡Do. New Shares,	10,000	50	5	10	10	10	
(2)§Maryport and Carlisle,	4,000	50	32	7	7	7	
(2) Midland Counties,	10,000	100	70	55	55	55	
(1)§Newcastle and Carlisle,	6,000	100	100	105	105	105	
§Ditto ¼ shares,		25	25	26	26	26	
(2) Northern and Eastern,	12,000	100	18	7½	6¾	6¾	
(2) North Midland,	15,000	100	75	71	60½	71	
(1)*North Union,	3,200	100	100	67½	67½	67½	
Do. New Shares,	3,200	50	50			64½	
(2) Preston and Wyre,	2,600	50	44			42	
(4)‡Sheffield and Manchester,	7,000	100	10	4	4	4	
(2)‡South-Eastern and Dover,	28,000	50	12	4½	4	4½	
Do. New Shares,			15	4⅛	3¾	4	
(1) St. Helen's, Runcorn Gap,			100			40½	
(1)§Stockton and Darlington,	1,000	100	100	205	205	205	14
(2) Thames Haven,	9,000	50	5				
(2) York and North Midland,	6,700	50	30	40½	30	37½	

Wooden Pavements.

To the Editor of the Repertory of Patents.

Sir,—Observing a number of blocks of wood lying in the Old Bailey, evidently prepared for being laid down to form a wooden pavement for the carriage way opposite the Sessions House, and finding the blocks to vary greatly in dimensions, I measured several of them, and found some only eight inches and a half long, while others were nine inches and three eighths. They are generally of the figure of a regular hexagonal prism, some of them, however, are a little conical, but the diameters vary so much, that it will be impracticable to fit them together, without leaving interstices between them, so great as to render the outer parts of blocks, liable to be chipped off by the feet of the horses and the wheels of the carriages passing over them.

The surface too of the ends of the blocks, each of which ought to be cut off exactly at right angles to the axis of the prism, forms, in many cases, oblique angles with that axis, and consequently, when the blocks are placed end upwards, one side will be higher than the other, and thus the pavement will necessarily have an uneven surface, and much of the value of the wooden pavement be lost.

Having attentively watched, for about four years, from 1827 to 1831, the effect of much traveling over a wooden pavement well executed in the principal gateway of Vienna, and observed that it appeared to wear much less than any other kind of pavement, I frequently, after my return to England, mentioned to our engineers the superiority of wooden blocks, placed with the end of the grain upwards for a carriage way, and recommended their universal adoption.

But the goodness and durability will depend on the excellence of the workmanship; the blocks ought all to be cut exactly to one gauge, and laid on an even bed; I should consider a difference of a tenth of an inch in either length or breadth, sufficient to disgrace any engineer, who would permit such blocks to be laid down contiguously. How great then must be my disgust at observing nearly an inch difference in the lengths, and more than an inch in the breadths, of those blocks about to be used in the Old Bailey.

Being thoroughly satisfied that neither comfort nor durability can possibly result from such excessively bad workmanship, and apprehensive that the numerous benefits and great economy of wooden pavements, will, for a length of time, be lost to the community if such a wretched specimen be allowed to influence public opinion, I deem it my duty to warn all those concerned, against a proceeding, which can only produce disappointment and public injury. I am Sir, your obedient servant,

John Isaac Hawkins,
Civil Engineer and Patent Agent.

Rep. Pat. Inven.

Steamboats in France.

The number of steam-boats in France has been very much increased lately, and the majority of the vessels are supplied with English engines. The engines are chiefly on the low-pressure principle, and are worked by English engineers, of whom there are twenty in the ports of the Seine only. The rate of pay is about 300 francs, or twelve pounds, a month, and board; while the pay of the captain of a river steamer is only 150 francs, or six pounds, a month, with board. The words of command in all these vessels are English,—"stop her," "head way," "back her," &c., surprise the pas-

senger, and afford an interesting proof of the influence which the English nation exercises abroad. The stokers are partly English, partly French, and some American negroes. The crews, especially of the river steamers, are a wretched set of lubbers, talking much more than they work, and causing all kinds of accidents and delays. The management is excessively bad, and the steersmen of the river steamers, who are pilots of the Seine, get intoxicated, and ask drinking money from the passengers. The strongest part of the equipage is certainly the crew of cooks and waiters, who are seldom less than half a score, with a regular *cuisine* at their disposal, to the gratification of the passengers' olfactory nerves. Most of the engines on the Paris and Havre stations have been supplied by Mr. Barnes, of London, late Barnes and Miller. The Seine steamers are very long (about 150 feet) and narrow, drawing only about two feet water, and yet in summer they often take the ground. In winter they cannot run, as the height of the water leaves no space to pass through the bridges. Iron boats have been recently introduced, and with good effect. Boats run from Paris to various places in the neighbourhood, but most of those for Rouen start from Pecq, a suburb of St. Germain, at the termination of the railway. From Rouen numerous boats run both up and down the river, and from Havre there is steam communication to Bourdeaux, Cherbourg, Caen, Dublin, Plymouth, Southampton, Portsmouth, London, Dunkirk, Rotterdam, Hamburgh, Copenhagen, and St. Petersburgh. Dunkirk is also a rising steam station, and communicates with Havre, Hull, and Rotterdam. At Havre the government propose to build a large steam dock for the navigation to the United States, in which they are desirous of participating with the English. Steamers now go from England to a great number of ports on the French coast, so as to make the union between the two nations still more intimate. A great part of the steam-boat passengers, if not the majority, are, however, English. Among these ports are Dunkirk, Calais, Boulogne, Dieppe, St. Valery-sur-Somme, Havre, Granville, St. Malo, and Bourdeaux. On the English side the communication is to Hull, London, Margate, Dover, Rye, Brighton, Portsmouth, Southampton, Weymouth, Plymouth, and Dublin. The surf of the steamers on the river Seine is very great, arising from the shallowness of the channel, on the sand banks of which the steamers are obliged sometimes to scrape their way. Small boats always make for the shore, and if they can, run up high and dry, boats lying on the banks being not unfrequently swamped. The few craft on the river Seine are principally Rouen boats, a long unwieldy barge, which obeys the helm with difficulty, and frequently embarrasses the channel. The coals used are partly English, from Newcastle, and partly Belgian, and the coke used is Belgian. Some of the engines are kept in very good order, but others are extremely dirty and rusty from the negligence of the engineers. Railway Mag.

Locomotive Power applied to Canal Transit.

On the 21st and 22d instant, an experiment was conducted on the Forth and Clyde Canal, of a novel and highly interesting nature, by John Macneil, C. E., and consulting engineer to the Canal Company. It is well known that the haulage of boats on this canal has hitherto been performed by horses, the rates of speed being for the heavy sloops, brigs, &c., in the London, Dundee, and other trades, about 1½ to 2 miles per hour, when drawn by 2 or 5 horses, according to the state of the weather, and for the swift or passengers boats, between 8 and 9 miles per hour, on an average, when drawn by

two horses. The object of the experiment was to ascertain the possibility of using locomotive steam power to draw the boats instead of horses; accordingly, a single line of rails, upon blocks, like an ordinary railway, was laid down for a considerable space along the canal banks, near lock 16; and a locomotive engine and tender, built by Mr. William Dodds, having been brought down the canal and set on the rails, on the morning of the 21st, Mr. Macneil, Mr. Johnston, the canal director, and several engineers and gentlemen, being present, the experiment commenced by attaching to the engine the towing line of the first passenger boat that made its appearance, and which contained upwards of 90 passengers, with their luggage. There was a trifling delay in disengaging the horses and tying the line to the engine, but this was amply compensated when the "Victoria" briskly set off, and almost immediately gained a speed of 17⅓ miles per hour, which she kept up round two curves, and until the termination of the rails made it necessary to stop, amid the cheers of the delighted passengers. This experiment was repeated, during the course of the day, with each passenger boat as it came to the railed space, and with equal success each time. On one occasion a towing rope, which was much decayed, got foul with a curb-stone and broke, but without causing the slightest inconvenience, except about one minute's delay. The engine employed being intended only for a slow trade, was not calculated to go at greater speed than 18 miles per hour, but it was the opinion of all present, that with proper passenger locomotives, a speed might be obtained, equal to that upon the best railways, few of the latter possessing the advantage secured by the canal bank of a *perfect level* throughout.

The nature of the motion was highly gratifying to all the passengers, being more uniform, steady, and smooth, than when the boats were drawn by horses.

Several of the heavy (masted) vessels were also taken in tow during the two days of trial, at the rates of 3, 3½, 4 and 5 miles per hour; and, on one occasion, two loaded sloops, and a large wagon boat, were together attached to the engine, and hauled with ease at the rate of 2¾ miles per hour, whilst only *one-fourth* of the steam was allowed to pass the throttle valve.

The foregoing statements render palpably apparent the immense advantages which might be gained by this new adaptation of steam power—a great economy in haulage expenses, as one engine might draw, at least, six sloops, which now would require from 18 to 24 horses, and, if necessary, at double the present speed; and a proportional increase of the important traffic on the canal, which might be reasonably expected.

Passengers would increase in a great proportion, when attracted by economy and speed of transport. The Union Canal might be traversed in two hours, and the Forth and Clyde Canal in 1½, instead of 4 hours and 3½, as at present, and this by only assuming 16 miles per hour, though more might easily be performed, as the experiments have shown. Lond. Mech. Mag.

Newly discovered Power in Projectiles.

An experiment was tried early on Thursday last with a newly-invented projectile. A large and strong-built boat was the subject of the experiment; the distance was left to choice, with the single proviso, that the object fired at should be in sight. The inventor, Captain Warner, launched with his own hand the destructive missile, which, reaching the boat at the water-line, exploded, fairly heaving her up, and scattering the planks into shivers. One

plank alone of the whole retained a breadth of about three inches, and perhaps two feet in length; the rest, and the keel itself, as they fell after the lapse of some seconds into the water, presented a mere mass of floating splinters to the eye, and portions of the wood were carried into the neighbouring fields to a considerable distance. The whole destruction was effected by the agency of two and a half pounds of combustible matter projected by an instrument of perhaps ten or a dozen pound's weight. There was no recoil whatever, nor any smoke or noise till the shell itself exploded against the vessel, and then the percussion of air was tremendous, as it threw down the nearest spectator, and was felt at a still greater distance like the discharge of an eighty-pounder, at least. At Kingston it created great commotion, as the explosion was attributed to the powder-mills at Hounslow; and since the fact has become known the excitement has greatly increased. No vessel of the line, probably, could have resisted the shock, or escaped total destruction from even the small quantity of combustibles experimented with. The most singular circumstance, perhaps, is, that not the slightest discoloration was visible on any of the fragments. The power consequently is quite novel, and the secret jealously guarded.—*Morning Chronicle.*

Athenæum, July 13, 1839.

Opening of the Versailles Railway.

This railway branches off from that of Paris to St. Germain, and passes through a rocky and troublesome country. On the 27th of April, 1837, the law was passed authorising Messrs. Rothschild to execute it; and on the 4th inst. it was opened, having taken not more than two years and three quarters for its completion. It was originally intended to have had an independent entrance into Paris, but by an agreement with the St. Germain Railway, the two lines have been united, so as to have a common depot. The line seems efficiently constructed, and the rails well laid, and the locomotives perform their duty satisfactorily. They are of English make, and were manufactured by Messrs. Sharpus of Manchester; the working engineers are also English. At an early hour in the morning the office was beset with a great crowd, awaiting the opening of the doors, and in the course of the day it was calculated that fifteen thousand persons were carried, realizing above forty thousand francs, or about sixteen hundred pounds. Being on Sunday, a great crowd was attracted, not only from Paris, but from the neighbouring towns, to witness the ceremony of the inauguration. The municipality had expressly reserved for this occasion the second celebration of the fetes of July; the grand waterworks played in the park, fireworks were let off in the evening, and amusements of all kinds united to attract to Versailles the greatest number of visitors which had ever been assembled in the town.

Railway Mag.

Steam Vessel Propellers.

A new kind of propeller, on the principle of a fish's tail, has been invented, to work under water, as the Archimedean screw. Experiments were tried with it on the Grand Surrey Canal, in comparison with the screw, of which the following is an extract from a letter we have received:—"The distance measured was 10 chains, or $\frac{1}{8}$th of a mile. Six experiments were made; first, with the *new* propeller; secondly, with the screw. Each pro-

peller was fitted to the same boat, which was 27 feet in length, 4 feet in breadth; and 1 foot in draught. There were four persons in the boat, and their weight, including the ballast, &c., might be about one ton. The circumstances as to the trim of the boat, the machinery and size of propeller, &c., were entirely the same. The results of six experiments on each of the propellers were as follows:—

New Propeller, moving through 10 *Chains Distance.*

Time.	Revolutions of Winch.	Revolutions of Propeller.	Rate of velocity in Miles per Hour.
140 secs.	90.3	451.3	3.4

Screw Propeller, moving through 10 *Chains.*

230	156.3	781.3	2.5

"The action of the new propeller was beautifully regular. No commotion in the water, no vibration in the boat, or counter steering, to suit the irregularity of the action of the screw, as in the case of the Archimedes, where the vibration from that cause was excessive; so much so, indeed, as to have worn the bearing of the shaft of the screw nearly 1-16th of an inch on one side; whereas, the new propeller glided through the water as smoothly as the tail of a fish, which furnished the idea for its form. As soon as the whole of the experiments are reduced, you shall have a copy of them."

Ibid.

Mechanics' Register.

Telegraphs in the Bristol Channel.

We learn from the *Bristol Mirror*, that the Town Council of Bristol have under consideration the propriety of establishing a line of telegraphs in the channel, in contemplation of its becoming the station for the South American and West Indian steamers.

Railway Mag.

Electric Superstition.

A few days since, a young man was killed by lightning, in the church of Epfig, in the Bas Rhin, while the bells were ringing to drive away the storm, according to the common superstition prevalent in many parts of France. This new proof of the danger arising from the practice has induced the Prefect of the department to issue an ordinance strictly forbidding it.

Ibid.

Metropolitan Patent Wood Pavement Company.

Capital £120,000 *in* 6000 *shares of* £20 *each. Deposit* £3 *per share.*

This Company, which has been introduced under very influential patronage, but which, in itself, is to us no proof of the value of the patent sought to

be applied in this country, of introducing "wood pavement for the carriage ways of the metropolis," appears, if the principle be good, to be one which only requires an active and economic management to render successful. No longer do our advertising columns teem with asphalte companies; the material rendered by them has been fairly subjected to the test of experience, and has failed in the accomplishment of the desired objects which were, in their several prospectuses, represented as being attainable, although for certain uses, it must be admitted, that asphalte is well calculated to supply the place of other materials. Thus, being again thrown back on the use, in the metropolis, of granite blocks or Macadamised road ways, we are subjected either to noise, mud, or dust, by the one or other application, in addition to which the Macadamised process is attended with a very serious expense. If, then, (and some proof has been already afforded,) "wood pavement" can be laid down economically, and that it will be lasting, there can be no doubt but it must come into general use, and, therefore, the prospects of a company are of an encouraging nature.

There is another company for the same object, but what are the peculiar features or advantages of each are unknown to us. A patent having been taken up in this instance, would imply an improvement; this, however, is to be seen. Mining Jour.

Artesian Well at Grenelle.

At the last setting of the Academy of Science, M. Arago stated that he had that morning been making some thermometrical experiments at the Artesian well at Grenelle, in order to ascertain the temperature at the depth which had already been attained, viz., 483 metres, or 1584 feet. When the workmen had reached 460 metres the chalk was of a green colour, indicating the proximity of water. Since then the chalk had become mixed with clay, and of a dark colour, a still stronger indication that the sheet of water which it is intended to meet is near. M. Arago used the thermometer of M. Walferdin, and after having taken all the necessary precautions in order that the pressure, which at such a depth is equal to fifty atmospheres, might not injure the bulb, six thermometers of the same kind were successively let down to a depth of 481 metres, care having been taken not to lower them until thirty-six hours had elapsed after the boring, in order that the heat which this work might have communicated should have subsided. The thermometers were left in the well for thirty-six hours. The heat at this depth was twenty-seven degrees of Reaumur, or 92¾ of Fahrenheit, being about twenty-three metres for each degree of temperature. M. Arago expressed a hope that no water might be found for 100 metres more, as in that case there would be a permanent hot spring at the very gates of Paris. Mining Review.

Dowie's Patent Boots and Shoes.

When the foot is under the pressure of the body, it is elongated. This principle of elongation seems to have been long admitted, inasmuch as all boots and shoes have hitherto been made a little longer than the foot of the wearer; but the difference in the degree of extension in the feet of different individuals appears to have been, in some measure, overlooked, as it rarely

happened that allowance was made for this difference; and the result has been, that many persons have never obtained shoes long enough for their feet, when thus extended, the measurement being generally taken when the foot is not under the pressure of the body. Another important consideration arises, from the circumstances connected with the altered positions of the foot in walking. As the foot extends in length from heel to toe, in proportion to the height of the arch, the strength of the ligaments, and the weight it has to support, the elongation has been found, by actual measurement, to vary from a quarter of an inch to a whole inch. * * *

Many years ago, I was much impressed with the imperfections in the structure of the boots and shoes in general use. After devoting much time and attention in endeavouring to remedy their defects, I believe that I have at length succeeded in attaining this object. This is effected by making those parts of the boots or shoes immediately under, and on each side of, the principal arch of the foot of an *elastic material*. This material is composed of caoutchouc and animal skin, so manufactured as to bestow on the fabric the elasticity of the caoutchouc, while it retains the tenacity and durability of leather. The introduction of this elastic substance allows considerable changes to be made in the form of the boots and shoes, and gives the wearer the free use of his feet and ankle joints in walking, to a much greater extent than any hitherto in use.—*Trans. Soc. of Arts of Scotland.*

Lond. Mech Mag.

Wire Sewn Boots and Shoes.

M. Sellier of Paris, has secured by a patent in France the right of using brass wire for attaching the upper leather to the welts of shoes and boots. He urges that this metallic thread allows neither moisture nor dust to enter the shoe, and furthermore that it does not rip. The sewing is performed with as much ease, as with waxed thread, nor is the work more costly. A member of the committee has worn a pair of Sellier's boots 18 months, in which time two strong soles were worn out, without any giving way whatever of the wire sewing. They were free from dampness, and from dust in a time of drought. *Bull. d'Encour. Sept.* 1838.

Statue of Dr. Dalton.

This statue, it appears, is completed, and now exhibiting at the Royal Institute. It is of white marble, remarkably clear from blemish. The proportions are colossal; the venerable philosopher is represented as seated in his study chair, in his robe as a doctor of civil law; and his usual posture has been preserved with considerable skill, taste, and good effect. His right elbow rests on the chair; three of the fingers support the chin, and the fore finger extends upwards towards the ear. His left arm is upon that of the chair, and the hand rests upon the upper edges of a volume, which is supported by the seat. His left leg is crossed over the right knee, and the left foot, which would otherwise be unsupported, rests upon a crucible, in which is a retort; and upon the ground beside them is lying a scroll, inscribed with some of the symbols used by the Doctor in denoting the atomic composition of bodies. In a shield at the back of the chair is engraven "John Dalton, D.C.L." and on one side, "Francis Chantrey, sculptor, 1837." —*Manchester Guardian.*

Athenæum.

Wood Engraving Machine.

The practice of engraving the outlines and rivers on wood, and then piercing the block and inserting the names of the places in type, has lately been revived; and where publishers are obliged either to print maps with the type, or to give none at all, this mode may answer very well, more especially when the object is to give the relative position of a few of the principal places, rather than a crowded list of names. Most of the larger maps in the *Penny Cyclopædia* are executed in this manner. The holes in the blocks are pierced with the greatest rapidity by gouges of different sizes acting vertically, and put in motion by machinery contrived by Mr. Edward Cowper, to whose great mechanical skill the art of steam printing chiefly owes its perfection.—*Jackson's Treatise on Wood Engraving.*

Lond. Mech. Mag.

New Alloys of Metals.

A curious and valuable discovery has just been made in the alloy of metals. A manufacturer of Paris has invented a composition much less oxidable than silver, and which will not melt at less than a heat treble that which silver will bear; the cost of it is less than 4*d.* an ounce. Another improvement is in steel; an Englishman at Brussels has discovered a mode of casting iron so that it flows from the furnace pure steel, better than the best cast-steel in England, and almost equal to that which has undergone the process of beating. The cost of this steel is only a farthing per pound greater than that of cast-iron.

Mining Jour.

New mode of Illuminating Clocks.

The Horse Guards clock was illuminated for the first time, on Tuesday, July 16, by means of the "Bude Light," which falls on the face; thus differing from the ordinary transparent clocks, to which it is much superior, both in clearness and beauty. It gives the clock-face an appearance of being shone upon by a very powerful moonlight.

Lond. Mech. Mag.

Artificial Ivory.

Certain parties in Sheffield have just obtained a patent for the making of a substance so nearly resembling ivory, and so applicable to all the purposes of that valuable material, that it is almost impossible to detect the difference. —*Sheffield Iris.*

Mining Rev.

Machine for Copying Oil Paintings.

M. Liepmann, a painter of eminence at Berlin, is stated to have invented a mechanical process for taking, in a very short time, a copy of any painting in oil, however old, with an exactitude which cannot be attained by the brush. M. Liepmann has exhibited his machine in the galleries of the Royal Museum at Berlin, and in the presence of the directors, made 110 copies of a portrait of Rembrandt, with the greatest success.—*Morning Herald.*

Athenæum.

LUNAR OCCULTATIONS FOR PHILADELPHIA, FEBRUARY, 1840.					Angles reckoned to the right or westward round the circle, asseen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
10	10	41	Im. m Pleiadum	7	90°	147°
10	11	42	Em.		284	338
16	16	20	Im. ν Leonis	5.6	359	51
16	16	52	Em.		294	348
17	5	51	Im. ϱ Leonis	4	102	53
17	6	37	Em.		212	161
17	7	24	Im. 49 Leonis	6	9	318
17	8	0	Em.		299	248
21	11	22	Im. 85 Virginis	6	51	7
21	12	32	Em.		258	202
27	17	29	Im. τ Sagittarii	4	111	77
27	18	52	Em.		261	242

Meteorological Observations for August, 1839.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	68	80	29.76	29.85	W.	Moderate.		Clear—do.
☽	2	64	66	.86	.85	N.E.	do.	.35	Rain—do.
	3	65	76	.60	.84	N.W.	do.		Cloudy—do.
	4	63	77	.50	.95	N.E.	do.		Clear—partially cloudy.
	5	64	79	.90	.90	N.E.	do.		Clear—cloudy.
	6	66	79	.90	.86	S.W.S.	do.		Clear—do.
	7	70	82	.84	.84	W.W.	do.		Clear—do.
⊗	8	68	74	.70	.60	S.	do.	.25	Cloudy—showery.
	9	68	77	.59	.57	N.	Brisk.		Clear—do.
	10	60	78	.70	.80	W.	Moderate.		Clear—do.
	11	60	80	.86	.90	W.	do.		Clear—cloudy.
	12	68	80	.90	.90	W.S.W.	do.		Cloudy—clear.
	13	64	78	30.00	30.00	N.	do.	1.20	Clear—do.—rain.
	14	60	76	.10	.10	W.	do.		Clear—clear.
	15	64	78	.10	.10	W.S.W.	do.		Clear—cloudy.
	16	58	62	29.70	29.70	N.E.	Gale.	1.25	Rain—rain.
☾	17	62	68	.80	.85	E.	Calm.	.75	Cloudy—showery.
	18	62	72	.90	.90	S.E.	Moderate.		Clear—cloudy.
	19	64	70	.90	.90	E.S.E.	do.		Fog—cloudy
	20	68	75	.90	.90	N E.	do.		Cloudy—partially do.
	21	69	77	.90	.90	S.	do.	.15	Cloudy—clear—rain.
	22	67	76	.86	.86	S.	do.	.20	Cloudy—rain.
☉	23	69	79	.80	.80	S.S.E.	do.		Cloudy—do.
	24	69	74	.76	.76	S.	do.		Cloudy—do.
	25	70	81	.85	.85	W.	do.	.2	Rain—clear.
	26	69	83	.85	.85	S.W.	do.	.25	Clear—do.—rain at night.
	27	72	82	.80	.80	W.	do.	.2	Partially cloudy—clear—rain.
	28	68	76	.85	.85	N.E.	do.		Cloudy—clear.
	29	56	62	.85	.95	N E.	do.		Cloudy—do.
	30	52	51	.80	.80	N E	Brisk.	.48	Rain—do.
	31	54	66	.90	90	W.	Moderate.		Cloudy—do.
	Mean	64.55	74.66	29 83	29.86			4.92	

	Thermometer.		Barometer.	
Maximum height during the month.	83.	on 26th.	30.10 on 14th. & 15th.	
Minimum " "	51.	30th.	29.50	4th.
Mean	69 695		29.845	

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

DECEMBER, 1839.

	County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.	Barometer. 7, A. M.	2, P. M.	9, P. M.
1	Philadelphia,															
2	Montgomery,															
3	Bucks,	Newtown,	L. H. Parsons,	30.90	39.14	31.86	58.00	14.00	33.97	.	15.	26.58	.	29.84	29.84	29.86
4	Lehigh,															
5	Northampton,															
6	Monroe,	Stroudsburg,	A. M. Stokes,	24.85	33.25	29.28	55.00	8.00	29.13	9⅔	.....	.....	.	29.44	29.41	29 44
7	Pike,															
8	Wayne,															
9	Susquehanna,	Silver Lake,	E. W. Rose,	24.13	30.16	25.87	44.00	7.00	26.72	.	5.	20.68	.	27.76	27.79	27.73
10	Luzerne,	Wilkesbarre,	Welding F. Dennie,	27.74	35.52	27.90	49.00	11.00	30.35	.	.....	.....	.	29.21	29.21	29.21
11	Schuylkill,	Port Carbon,	Port Carbon Lyceum,													
12	Berks,	Reading,	C. F. Egelmann,	30.00	34.71	32.00	55.00	19.00	32.24	.	.....	.....	.	29.69	29.63	29.65
13	Chester,															
14	Delaware,	Haverford,	Haverford School,	30.58	36.54	32.00	56.00	17.00	32.94	2	18.	29.90	.	29.39	29.39	29.43
15	Lancaster,	Lancaster,	Conservatory of Arts,	30.95	39.10	32.43	56.00	15.50	34.16	⅔	15.	30.07	.	29.34	29.27	29.30
16	York,	York,	Calvin Mason,	32.90	39.07	31.00	54.00	14.00	34.32	.	12.	28.95	.	29.46	29.45	29.47
17	Lebanon,															
18	Dauphin,															
19	Northumberland,	Northumberland,	Andrew C. Huston,	27.44	36.66	30.27	50.00	12.50	31.49	.	7.	20.10	.	29.25	29.26	29.29
20	Columbia,															
21	Bradford,															
22	Tioga,															
23	Lycoming,															
24	Union,															
25	Mifflin,															
26	Juniata,	Mifflintown,	J. A. Rinkead,	27.29	38.13	30.04	55.00	10.00	31.82	⅔	....	.....	.	29.35	29.33	29.35
27	Perry,															
28	Cumberland,	Carlisle,	Prof. W. H. Allen,	28.10	35.79	30.07	50.00	8.00	31.32	1⅓	4.	25.90	2	29.23	29.21	29.22
29	Adams,	Gettysburg,	Prof. M. Jacobs,	28.61	36.69	31.11	51.25	8.00	32.14	.	8.	26.33	.	29.25	29.23	29.25
30	Franklin,															
31	Huntingdon,															
32	Centre,	Bellefonte,	John Harris,	24.76	31.03	26.85	49.00	6.00	27.55	2⅓	5.	19.96	7	29.11	29.13	29.12
33	Potter,															
34	M'Kean,	Smithport,	Richard Chadwick,	22.61	33.10	24.42	50.00	1.00	26.71	.	....	.....	.	27.94	27.98	27.99
35	Clearfield,															
36	Cambria,	Ebensburgh.	Richard Lewis,	23.61	29.26	24.84	48.00	7.00	25.90	.	....	.....	.	27.62	27.59	27.61
37	Bedford,															
38	Somerset,	Somerset,	George Mawry,	23.90	26.75	25.13	33.00	8.00	25.26	15⅔	....	....	.	27.76	27.74	27.79
39	Indiana,	Indiana,	Richard White,	30.68	34.74	36.68	50.00	16.00	33.97	.	—8.	24.24	.	28.43	28.43	28.44
40	Jefferson,	Rose Cottage,	C. C. Gaskell,	23.19	28.67	23.57	46.00	—10.00	25.14	⅔	....	.....	.	28.75	28.73	28.73
41	Warren,															
42	Venango,															
43	Armstrong,															
44	Westmoreland,															
45	Fayette,	Uniontown,	Rev. J. P. Weithers,	29.17	33.07	29.90	50.00	0.00	30.71	.	0.	27.00	.	28.85	28.82	28.85
46	Green,															
47	Washington,															
48	Allegheny,															
49	Beaver,															
50	Butler,	Butler,	Jacob Mechling,	26.52	32.87	28.00	48.00	— 8.00	29.13	.	...	....	.	....	....	...
51	Mercer,															
52	Crawford,															
53	Erie,	Erie,	Park & Reid,	30.47	34.77	31.97	50.00	19.00	32.40	.	19.	27.15	1	29.22	29.20	29.21

er.		Register.			Barometer.							Weather.										
	Days omitted.	Lowest.	Mean.	Days omitted.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.	North.	N. N. E.	N. E.
7	.	15.	26.58	.	29.84	29.84	29.86	30.50	28.90	29.85	.	8⅓	22⅔	.	....	....	....	..	7.170	2	.	10⅓
3	9⅔	.....	.....	.	29.44	29.41	29.44	29.80	29.00	29.43	8	7	15	9	....	....	....	..	.....	4	.	2⅓
2	.	5.	20.68	.	27.76	27.79	27.73	28.10	26.90	27.76	.	7⅔	23⅓	.	1	11	...	..	2.790	5⅔	.	1⅔
5	.	.....	.....	.	29.21	29.21	29.21	29.52	28.18	29.21	⅔	6⅓	24⅔	.	2	7	....	..	1.995	4⅓	.	2⅔
4	.	.....	.....	.	29.69	29.63	29.65	30.00	28.70	29.66	⅓	7⅓	23⅔	.	4	5	1	..	.....	2⅔	.	3⅔
4	2	18.	29.90	.	29.39	29.39	29.43	29.85	28·38	29.40	5⅔	6	19⅓	5⅔	....	....	....	..	3.607	1⅔	⅔	6⅔
6	⅔	15.	30.07	.	29.34	29.27	29.30	29.66	28.28	29.30	⅓	8⅔	22	⅓	5	6	3	..	3.648	2⅔	2	3⅓
2	.	12.	28.95	.	29.46	29.45	29.47	29.80	28.50	29.46	.	.	.	.	....	....	....	..	.....	.	.	10⅔
9	.	7.	20.10	.	29.25	29.26	29.29	29.61	28.28	29.27	.	.	.	.	4	9	2	..	3.177	7	.	5
2	⅓	....	.....	.	29.35	29.33	29.35	29.64	28.39	29.34	⅔	5⅓	20⅔	5	....	...	...	..	5.375	.	.	2⅓
2	1⅔	4.	25.90	2	29.23	29.21	29.22	29.54	28.45	29.22	1⅔	4⅔	24⅓	1⅔	2	5	2	..	5.199	⅔	.	3⅓
4	.	8.	26.33	.	29.25	29.23	29.25	29.52	28.00	29.24	.	9	22	.	....	....	....	..	.....	2	2	4
5	2⅓	5.	19.96	7	29.11	29.13	29.12	29.50	28.25	29.12	2⅓	3⅔	24⅓	2⅓	....	....	....	..	4.046	1⅓	.	9
1	.	....	.....	.	27.94	27.98	27.99	28.25	27.30	27.97	.	4⅓	26⅓	⅓	1	14	....	..	7.296	1	.	⅔
0	.	....	.....	.	27.62	27.59	27.61	27.90	26.85	27.61	.	3	27	1	1	13	...	..	.....	⅔	.	1⅔
6	15⅔	....	....	.	27.76	27.74	27.79	28.07	27.10	27.76	15⅔	.	.	.	....	....	....	..	.....	⅓	.	⅔
7	.	—8.	24.24	.	28.43	28.43	28.44	28.70	27.70	28.43	.	5	25⅔	⅓	3	16	....	..	4.132	.	.	1⅔
4	⅔	....	.....	.	28.75	28.73	28.73	29.08	28.00	28.74	⅔	4	26⅓	⅔	....	....	.....	..	3.235	4	.	⅓
1	.	0.	27.00	.	28.85	28.82	28.85	29.21	28.20	28.84	.	4⅓	16⅔	.	4	15	1	..	9.200	.	1	3⅓
3	.	...	....	.	....	....	....	....	....	....	.	.	.	.	1	12	....	..	6.354	⅓	.	⅓
0	.	19.	27.15	1	29.22	29.20	29.21	29.59	28.63	29.21	.	1	29⅔	⅓	....	....	....	..	.....	1⅓	1	3⅔

Winds.																		Hygrometer.					
North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew point.	Wet Bulb.	Days omitted.	No. of Report.
2	.	10 1/3	.	.	.	1/6	.	1 2/3	.	3	.	.	.	13 2/3	.	.	.	33.84	.	.....	....	.	911
4	.	2 1/3	2/3	2 1/3	1/3	3/6	.	.	.	2/3	.	3 2/3	.	5 2/3	1/3	.	10 1/3	....	.	.....	....	.	908
5 2/3	.	1 2/3	.	.	.	1 1/3	.	.	.	1/3	.	3	.	12	.	7	.	....	.	.....	....	.	921
4 1/3	.	2 1/3	.	.	.	1/3	.	1 2/3	.	4 1/3	.	1 2/3	.	16 1/3	.	.	.	....	.	.....	....	.	916
2 2/3	.	3 2/3	.	3	.	1 2/3	.	.	.	1/3	.	1 2/3	2/3	17 2/3	.	.	.	....	.	.....	....	.	902
1 2/3	1/3	6 2/3	1/6	1 1/6	.	.	.	1/6	.	1	1/3	5 1/3	1 2/3	8	1	1/3	2	....	.	.....	....	.	897
2 1/3	2	3 1/6	2 1/6	.	.	1/6	1/6	1	1/6	1	1/3	3 1/3	2	7	3 1/3	.	1/6	30.24	3	.....	36.48	3	927
.	.	10 2/3	.	.	.	1/3	.	.	.	1 1/3	.	1/3	.	18 1/3	.	.	.	....	.	.....	....	.	924
7	.	5	.	2 1/3	.	1 1/3	1/3	2/3	.	.	.	6 1/2	1/3	4 1/3	1 1/3	2	.	....	.	.....	42. 45	.	896
.	.	2 1/3	.	1	.	1 1/3	.	.	.	1	.	1	.	11 1/3	.	12 1/3	2/3	....	.	.....	....	.	895
2 2/3	.	3 1/3	.	1	.	1 2/3	.	1	.	1 1/3	1/3	3 2/3	1/3	8	2/3	6 2/3	2 1/3	....	.	.....	....	.	909
2	2	4	.	2/3	.	.	1/3	1 1/3	1/3	1/3	.	4	2	7	2 2/3	4	.	26.44	3	.....	33.97	3	932
1 2/3	.	9	.	.	.	1	2/3	1/3	1/3	2	.	2	.	11	2/3	.	2 1/3	....	.	.....	....	.	901
1	.	2/3	.	8 1/3	.	2 1/3	.	.	.	2	.	11	.	3 1/3	.	2 1/3	.	....	.	.....	....	.	944
1/3	.	1 2/3	.	2 1/3	.	4	1	1/3	.	2/3	1/3	9	2 2/3	6 2/3	1/3	1	.	....	.	.....	...	.	898
1/3	.	2/3	1 1/3	2	.	.	.	.	.	1 1/3	.	2 1/3	1 1/3	6 1/3	1/3	.	15	....	.	.....	....	.	917
1/3	.	1 2/3	.	5	.	2/3	.	1 2/3	.	1 1/3	.	6	.	3 2/3	.	10 2/3	.	....	.	.....	....	.	929
4	.	2/3	.	.	.	1/3	.	1/3	1/3	4 1/3	.	4 1/3	2/3	2/3	.	14 2/3	1	40.07	17	.....	37.14	17	930
.	1	3 1/3	.	.	.	1 1/3	.	.	.	6	.	7	.	11	.	1 1/3	.	....	.	.....	23.71	.	912
1/3	.	3/3	.	9 1/3	.	1/3	.	.	.	13 2/3	.	4	.	1 2/3	.	.	1	....	.	....	....	.	907
1 1/3	1	3 2/3	1	1/3	1/3	3 2/3	2/3	1 2/3	1/3	4	.	7 1/3	2/3	3	1	1	.	....	.	.....	....	.	925

LUNA	
Day.	H
10	1
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